THE CITY OF
GREATER GEELONG

NORTHERN AND WESTERN GEELONG GROWTH AREAS

BIODIVERSITY DATASET

CITY OF GREATER GEELONG

31 AUGUST 2022

INTRODUCTION

The City of Greater Geelong (the City) is responsible for planning the Northern and Western Geelong Growth Areas that will ultimately be home to 110,000 new residents at full development. An important step in the planning process is to understand the existing ecological conditions on site.

The City of Greater Geelong commissioned Ecology and Heritage Partners Pty Ltd to undertake detailed ecological investigations within two separate study areas identified as part of the Western Geelong Growth Area (WGGA) and the Northern Geelong Growth Area (NGGA). This area is the scope of the Strategic Assessment under part 10 of the EPBC Act. This report is the *EHP Existing Ecological Conditions: Northern and Western Geelong Growth Areas – July 2021* (EHP Report) – refer to Attachment 1.

This study included a review of literature, previous site assessments and field surveys by qualified ecologists between November 2019 and December 2020. Over 200 person days were spent surveying native vegetation, ecological communities and significant flora and fauna species.

In October 2021 the City provided an opportunity for those with land included within the EHP 2021 assessment area to supply further information for consideration in the development of the Part 10 strategic assessment. The City advised that while the EHP 2021 report has been broadly accepted by the Department of Climate Change, Energy, the Environment and Water and the Department of Environment Land Water and Planning, additional information may be submitted for consideration where landholders have concerns with mapping anomalies and/or assumptions.

Nine submissions were received from landowners during this process. An independent assessment of these reports was undertaken to inform whether the submitted information and data improves or strengthens the EHP 2021 findings (i.e. by addressing uncertainties, anomalies, inaccuracies or assumptions).

Submissions relating to changes in on-ground conditions (e.g. increased weed cover, altered land management practices etc.) or seasonal variability since the EHP 2021 surveys were not considered in the evaluation due to the volatile nature of grasslands.

The evaluation criteria were:

- Differences in mapping between landowner submissions and the EHP 2021 dataset, where landowner surveys were undertaken in the same season as EHP 2021. EHP undertook Vegetation Quality Assessment (VQA) surveys between November 2019 and January 2020.
- Where EHP has acknowledged that they were in error.
- Small scale refinements to address mapping anomalies and inaccuracies.

The following changes were accepted to inform the final project data set:

1. EHP has acknowledged and field verified native vegetation mapping errors on the property at 450 Elcho Road, Lovely Banks. The dataset is updated to include the corrected mapping from EHP for this

property. This sees a reduction in the native vegetation, no NTGVVP mapped and a reduction in the potential habitat for striped legless lizards.

2. Small scale refinements for the project dataset for:
    a. 35 Staceys Road, Lovely Banks – the driveway will be excluded from the native vegetation habitat zone (0.1 ha) and the driveway, outbuildings and house will be removed from the GSM habitat (1.1 ha)
    b. 435 Elcho Road, Lovely Banks – the dam, house and driveway will be removed from the GSM habitat (0.3 ha)
    c. 480 – 530 Heales Road, Lovely Banks – treed area removed from GSM habitat (0.41ha)
    d. 460 Evans Road, Lovely Banks – house and treed area removed from GSM habitat (0.67ha)
    e. 350 Elcho Road, Lovely Banks – treed areas removed from GSM habitat (5.83ha)

The revised maps are provided as Attachment 2. These maps supersede figures 2, 2a, 2b, 7 and 9a in the EHP report.

Going forward this revised data set will be known as the 'assessment dataset'. The spatial data is available for downloading from https://www.geelongdataexchange.com.au/pages/home/

The dataset will be used for:

- At the strategic scale to guide decision-making on the location and extent of native vegetation and fauna habitat that will be retained and removed as part of the future development of the precincts;
- The preparation of the Plan and strategic impact assessment report under the EPBC Act; and
- The preparation of native vegetation precinct plans for Elcho Road East and Creamery Road and any precinct structure plans that come on to the development program in 2023/24.

The terms of reference for the Part 10 strategic assessment requires that we use the best available information to inform the project. The dataset, landowner reports and recent observations about condition and modelled data for unassessed areas will inform the strategic assessment.

Future PSPs beyond the timeframes outlined above will be surveyed to inform native vegetation precinct plans.

SUMMARY OF VALUES

Summary of the ecological values that occur within the assessed areas of the NWGGA

Species diversity	Moderate assemblage of plants and animals, with 84 flora species and 75 fauna species recorded during the ecological surveys

Native vegetation	WGGA
	• 69.379 hectares of native vegetation represented by three EVCs:
	  ○ *Low Rainfall* Plains Grassland (EVC 132_63) 41.479 hectares;
	  ○ Creekline Grassy Woodland (EVC 68) 4.859 hectares;
	  ○ Floodplain Riparian Woodland (EVC 56) 23.107 hectares;
	• 102 Large Trees in patches;
	• 2 Large Scattered River Red-gum *Eucalyptus camaldulensis*.
	
	NGGA
	• 148.26 hectares of remnant vegetation represented by one EVC and one DELWP modelled wetland:
	  ○ *Low Rainfall* Plains Grassland (EVC 132_63) 146 hectares;
	  ○ Current Wetlands (DELWP) 2.259 hectares.
	• Three Scattered Trees (one Large) Grey Box *Eucalyptus microcarpa*

Wetlands	• The NGGA site is approximately 4.5 kilometres west of Limeburners Bay – a part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site. • The Moorabool River system (western boundary of the WGGA) flows into Lake Connewarre - part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site.
Significant ecological communities	• A total of 15.9 hectares of the nationally significant ecological community *Natural Temperate Grassland of the Victorian Volcanic Plain* is present in the study area • A total of 129 hectares of the *Western (Basalt) Plains Grassland Community* is present in the study area (Figure 2)
Significant flora species	• No nationally significant flora were recorded in the study area. • Assumed presence of Adamson's Blown-grass *Lachnagrostis adamsonii* within suitable habitat adjacent to Cowies Creek in the WGGA. • One State significant flora was recorded within the study area: ○ Leafless Bluebush *Maireana aphylla*

Significant fauna species	• Known presence of three nationally significant fauna:
	  ○ Confirmed presence of an important population of Growling Grass Frog along the Cowies Creek corridor;
	  ○ 187.49 hectares of suitable habitat for Striped Legless Lizard within the NGGA;
	  ○ 680 hectares of confirmed habitat for Golden Sun Moth within the NGGA.
	• Known presence of one State significant fauna:
	  ○ Platypus *Ornithorhynchus anatinus.*
	• Known presence of two Regionally significant fauna:
	  ○ Eastern Long-necked Turtle *Chelodina longicollis;*
	  ○ Spotted Harrier *Circus assimilis.*

Attachment 1

ecology & heritage partners

Final Report

Existing Ecological Conditions: Northern and Western Geelong Growth Areas

Prepared for

City of Greater Geelong

July 2021



Ecology and Heritage Partners Pty Ltd

MELBOURNE: 292 Mt Alexander Road Ascot Vale VIC 3032 **GEELONG:** PO Box 8048 Newtown VIC 3220
BRISBANE: Level 22, 127 Creek Street Brisbane QLD 4000 **ADELAIDE:** 22 Greenhill Road Wayville SA 5034
CANBERRA: Level 6, 39 London Circuit, Canberra ACT 2601 **SYDNEY:** Level 5, 616 Harris Street, Ultimo, NSW, 2007
www.ehpartners.com.au | 1300 839 325

DOCUMENT CONTROL

Assessment	Existing Ecological Condition Report
Address	Northern and Western Geelong Growth Areas
Project number	12896
Project manager	Shannon LeBel (Associate Ecologist / Geelong Resource Manager))
Report reviewer	Aaron Organ (Director / Principal Ecologist) and Andrew Hill (Director / Principal Ecologist)
Other EHP staff	Jordan Whitmore (Consultant Botanist), Elyse Harrison (Consultant Botanist), Nerissa Crabbe (Botanist), Jack Pascoe (Botanist).
Mapping	Monique Elsley (GIS Coordinator)
File name	12896_EHP_ExCond_NWGGA_CoGG_Finalv3_09072021
Client	City of Greater Geelong
Bioregion	Victorian Volcanic Plain
CMA	Corangamite
Council	City of Greater Geelong

Report versions	Comments	Comments updated by	Date submitted
Draft	Draft submitted to client for review		27/05/2020
Draft 2	Updates to report and mapping based on detailed review and comment by DELWP and CoGG. Inclusion of impact assessment	SLB / JW	30/07/2020
Draft 3	Updates to report and mapping based on detailed review and comment by DAWE, DELWP and CoGG. Inclusion of method and results for additional targeted surveys for SRF, GSM and SLL. Impact assessment removed – to be provided as a separate, stand-alone document.	SLB	11/02/2021
Final	Updates and clarifications to report and mapping based on detailed review and comment by DAWE, DELWP and CoGG.	SLB	28/05/2021
Final v2	Minor updates and clarifications in response to comments by CoGG.	SLB	02/07/2021
Final v3	Minor grammatical updates and clarifications	SLB	09/07/2021

Acknowledgements

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

- Alexander Schmidt, Ben Southby and Jess Cook (City of Greater Geelong) for project background and context and site information
- The landowners and residents who permitted access to the study area;
- The Victorian Department of Environment, Land, Water and Planning for access to ecological databases and discussion on survey methodology;
- The Commonwealth Department of Agriculture, Water and the Environment for access to ecological databases;

Copyright © Ecology and Heritage Partners Pty Ltd

This document is subject to copyright and may only be used for the purposes for which it was commissioned. The use or copying of this document in whole or part without the permission of Ecology and Heritage Partners Pty Ltd is an infringement of copyright.

Disclaimer

Although Ecology and Heritage Partners Pty Ltd have taken all the necessary steps to ensure that an accurate document has been prepared, the company accepts no liability for any damages or loss incurred as a result of reliance placed upon the report and its contents.

GLOSSARY

Acronym	Description
AVW	Atlas of Victorian Wildlife
BCS	Biodiversity Conservation Strategy
CaLP Act	*Catchment and Land Protection Act 1994*
CAMBA	China Australia Migratory Bird Agreement
CMA	Catchment Management Authority
DAWE	Department of Agriculture, Water and the Environment
DELWP	Department of Environment, Land, Water and Planning
DoEE	(former) Commonwealth Department of the Environment and Energy
EES	Environment Effects Statement
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EVC	Ecological Vegetation Class
FFG Act	*Flora and Fauna Guarantee Act 1988*
GGF	Growling Grass Frog *Litoria raniformis*
GSM	Golden Sun Moth *Synemon plana*
HabHa	Habitat Hectare
JAMBA	Japan Australia Migratory Bird Agreement
MSA	Melbourne Strategic Assessment
NES	National Environmental Significance
NGGA	Northern Geelong Growth Area – defined in this report as the area shown in Figure 1 and Figure 2.
NTGVVP	Natural Temperate Grassland of the Victorian Volcanic Plain ecological community
NVIM Tool	Native Vegetation Information Management Tool (DELWP)
NVPP	Native Vegetation Precinct Plan
NWGGA	Northern and Western Geelong Growth Area
PMST	Protected Matters Search Tool
PSP	Precinct Structure Plan
SLL	Striped Legless Lizard *Delma impar*
SRF	Spiny Rice-flower *Pimelea spinescens* subsp. *spinescens*
Study Area	Refers to areas within the NWGGA that were subject to the on-ground assessments
TRZ	Tree Retention Zone
VBA	Victorian Biodiversity Atlas
VPA	Victorian Planning Authority
WGGA	Western Geelong Growth Area – defined in this report as the area shown in Figure 1 and Figure 3.
WoNS	Weeds of National Significance

EXECUTIVE SUMMARY

Introduction

Ecology and Heritage Partners Pty Ltd was commissioned by the City of Greater Geelong (CoGG) to undertake detailed ecological investigations within two separate study areas identified as the Western Geelong Growth Area (WGGA) and the Northern Geelong Growth Area (NGGA). Both areas are positioned west and north of the Geelong Ring Road, on the outskirts of Geelong, Victoria.

Both the WGGA and NGGA were identified in the G21 Regional Growth Plan as being potentially suitable for development aimed at accommodating the medium, and longer-term growth of Geelong. In late 2015, CoGG committed to developing an Integrated Infrastructure Delivery Plan (IIDP) and Framework Plan for the Western and Northern Geelong Further Investigation areas.

The findings presented herein will be used by the CoGG to inform decisions regarding the future planning and development of six precinct structure plans (PSPs) within the study area, and in particular, to guide the CoGG in determining the location and extent of native vegetation and fauna habitat that will be retained and removed as part of the future development of the precincts. This information will be used by the successful contractor to prepare six Native Vegetation Precinct Plans (NVPPs), including the initial two PSPs, Elcho Road East PSP (NGGA) and Creamery Road PSP (WGGA) over the next two years.

In addition, the findings outlined in this report will be used as part of any necessary approvals under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Methods

Relevant literature, online-resources and databases were reviewed to determine the flora and fauna values across the study area. This included EPBC Act policy statements for listed species and ecological communities, FFG Act Action Statements, National Recovery Plans, and State Advisory Lists.

A review of several ecological assessments that have previously been undertaken within the NGGA and WGGA that describe the known or likely ecological values present, was undertaken to determine the potential occurrence of listed species and ecological communities, and to inform where targeted significant species surveys should be undertaken.

The field surveys were undertaken by qualified ecologists within the WGGA and NGGA study area between November 2019 and December 2020. The field surveys sought primarily to assess the extent and condition of native vegetation and potential flora and fauna habitat, with particular consideration given to significant species and ecological communities. Ecological surveys were undertaken to optimise the survey timing, methods and frequency to enable sampling of those flora and fauna species that are detectable at certain time of the year.

All fieldwork was carried out under the appropriate licences, including a Research Permit (1008283) and Scientific Procedures Fieldwork Licence (SPFL20005) issued by DELWP under the *Wildlife Act 1975,* and an Animal Research permit issued by the Wildlife and Small Institutions Animal Ethics Committee (05.17).

Targeted surveys were undertaken for nationally significant flora (Adamson's Blown-grass *Lachnagrostis adamsonii,* Matted Flax-lily *Dianella amoena*, Clover Glycine *Glycine latrobeana,* Button Wrinklewort *Rutidosis leptorhynchoides*, Large-headed Fireweed *Senecio macrocarpus*¸ Spiny Rice-flower *Pimelea spinescens* subsp. *spinescens*) and nationally significant fauna (Striped Legless Lizard *Delma impar*, Growling Grass Frog *Litoria raniformis*, Golden Sun Moth *Synemon plana,* Australian Grayling *Protoroctes maraena* and Little Galaxias *Galaxiella toourtkoourt*) between November 2019 and December 2020. Survey location, timing and extent are summarised in Table 4.

Over 200 person days (excluding travel) were spent surveying native vegetation, ecological communities and significant flora and fauna species.

The ecological site assessment was restricted to parcels/properties where access was permitted (Figure 2; Figure 3). This resulted in a total of 754.82 hectares out of a total of 2,245 hectares (approximately 33.6%) of the NGGA, and 100.85 hectares out of a total of 770 hectares (approximately 13.1%) of the WGGA not being subject to on-ground assessments.

Although the majority of parcels that were not surveyed comprise rural residential dwellings that are likely subject to regular disturbance (i.e. mowing), these parcels may still support areas of suitable habitat consistent with those already confirmed within the NGGA and WGGA during the 2019/20 and 2020/21 survey seasons. In addition, based on visual assessments from roadsides where native vegetation was observed along with the presence of modelled extant (2005) native vegetation and Landcover data, additional patches of native vegetation are highly likely to be present within these unassessed areas.

It is recommended that CoGG further investigates the possibility to gain access to parcels that have not been surveyed to document the quality and extent of native vegetation, and to determine the presence or otherwise of any significant species (e.g. Spiny Rice-flower, Striped Legless Lizard and/or Golden Sun Moth), and listed ecological communities [e.g. *Natural Temperate Grassland of the Victorian Volcanic Plain* (NTGVVP)].

If suitable habitat for significant flora or fauna is present, then targeted surveys would need to be undertaken in accordance with the relevant survey guidelines.

Ecological values of the NWGGA, as determined through field assessments and targeted surveys undertaken within the accessible property parcels, are summarised below.

Results

Most of the study area is highly modified due to past and current agricultural and farming practices and is dominated by non-indigenous grasses and weeds (i.e. pasture grasses). Much of the indigenous vegetation and terrestrial fauna habitat remaining within the study area is confined to riparian corridors (i.e. Moorabool River, Cowies Creek), or agricultural areas not subjected to historical cropping. Native vegetation, where present within existing farmland, is highly modified with vegetation generally lacking structure and exhibiting a low diversity of native species.

Flora

Eighty-four flora species (36 indigenous and 48 non-indigenous or introduced) were recorded within the study area on accessible parcels during the field assessment. No nationally listed flora species were identified during the targeted surveys across the study area. A single species, Adamson's Blown-grass *Lachnagrostis adamsonii* has been historically recorded in 1995 within the WGGA study area, and in 2001 and 2002 adjacent to the

WGGA in Cowies Creek, however the record was searched for, but was not observed during the field assessments. However, Adamson's Blown-grass is to be assumed as present based on the presence of suitable habitat (albeit, marginal) within Cowies Creek and relatively recent historical records.

A single state significant flora species, Leafless Bluebush *Maireana aphylla* was recorded at the north eastern boundary of the NGGA study area.

Although no other state listed species were recorded within the accessible areas of the NWGGA, known records of Melbourne Yellow Gum *Eucalyptus leucoxylon* subsp. *connata* were confirmed to occur within approximately one kilometre to the south of the WGGA.

Given additional State significant species were not detected through ecological surveys undertaken by Ecology and Heritage Partners, any populations within the assessed areas of the NWGGA that may occur are expected to be very small in numbers and possibly represented by only a few individuals.

Detailed vegetation mapping completed across the study area recorded three Ecological Vegetation Classes (EVC) (Plains Grassland EVC 132, Floodplain Riparian Woodland EVC 56, and Creekline Grassy Woodland EVC 68) within the assessed study area, comprising 69.379 hectares of native vegetation within the WGGA and 153.647 hectares within the NGGA (excluding mapped 'Current Wetlands'). A total of 104 Large Trees (all River Red-gums) were recorded within the WGGA study area, and three scattered trees (one large) (Grey Box *Eucalyptus macrocarpa*) were recorded within the NGGA study area. A total of 2.259 hectares of 'Current Wetland' as modelled by the Department of Environment, Land, Water and Planning (DELWP) is also present within the assessed NGGA study area, with an additional modelled wetland present in the unassessed area comprising a total of 8.12 hectares.

Fauna

Seventy-five fauna species (62 native species and 13 introduced species) were recorded within the study area. A low diversity of mammals was detected, comprising eight species, including Eastern Grey Kangaroo *Macropus giganteus*, Common Brushtail Possum *Trichosurus vulpecula* and introduced European Rabbit *Oryctolagus cuniculus*. A range of bird species were detected, including woodland and wetland species, along with those adapted to open and/or modified landscapes. Aquatic surveys identified the presence of an active burrow of the State significant Platypus *Ornithorhynchus anatinus,* which was observed within the banks of the Moorabool River. While the species itself was not observed, it is likely that a resident population occurs along Moorabool River. One regionally significant species Eastern Long-necked Turtle *Chelodina longicollis,* was recorded within Cowies Creek (WGGA), and the regionally significant Spotted Harrier *Circus assimilis* was observed flying over grassland within the NGGA and WGGA.

Approximately 50 Growling Grass Frog were detected along Cowies Creek within the WGGA over two nights during the targeted surveys. Taking into consideration the known distribution of the species within Cowies Creek, the distribution of key habitat attributes along the waterway and the potential for the species to utilise the waterway, Cowies Creek is considered to support an important population of the species, and acts as an important habitat corridor throughout the WGGA. Although not recorded within the Moorabool River,

A large population of Golden Sun Moth was confirmed to occur within the NGGA, with over 2000 individuals recorded during the targeted surveys. Where Golden Sun Moth was recorded, confirmed habitat was mapped where all areas of contiguous habitat supporting the species preferred food plants (i.e. moderate or higher

cover of Wallaby-grass *Rytidosperma* spp., and/or Chilean Needle-grass *Nassella neesiana*) were present. Overall, a total of 693.69 hectares of confirmed Golden Sun Moth habitat was recorded within the NGGA.

A total of 45 individual Striped Legless Lizard were recorded within the NGGA under 10 different tile grids. Sites where the species was recorded generally represent the highest quality habitat for Striped Legless Lizard within the NGGA. These areas supported a high cover of surface rock, cracking soils and tussock-forming grasses providing inter-tussock space. The high cover of surface rock at these sites also precludes regular slashing, which maintains a higher biomass and dense tussock structure throughout the year.

Based on the location of the confirmed records of the species and quality and extent of habitat, a total of 103.89 hectares of confirmed Striped Legless Lizard habitat is present within the NGGA (Figure 7). An additional 83.6 hectares of suitable habitat (i.e. comprising predominantly native grassland with cracking soils and surface rock) is also present. Although the species was not recorded in these areas, this habitat is still considered suitable, and as per the referral guidelines for the species, if the species is detected during surveys, then all suitable habitats should be considered as occupied. This equates to a total area of suitable Striped Legless Lizard habitat within the NGGA of 187.49 hectares.

Golden Sun Moth and Striped Legless Lizard were not recorded within the WGGA despite detailed targeted surveys being undertaken across potentially suitable habitats over an appropriate duration. Similarly, Australian Grayling or Little Galaxias were not detected within the study area during the aquatic surveys along Moorabool River. Based on the number of previous records, it is considered that Australian Grayling is likely to be present within the broader Moorabool River catchment. However, there are several barriers along the Moorabool River at the Batesford Quarry that are likely to prevent fish accessing habitat further upstream to the WGGA.

It is understood that the Corangamite Catchment Management Authority (CMA) propose to remove these barriers over the next 2-3 years, and once these barriers are removed, it is likely Australian Grayling will disperse further upstream along the Moorabool River into the WGGA. Future planning of the WGGA PSPs should assume the presence of Australian Grayling and Little Galaxias.

No other nationally or State significant species were recorded during diurnal or targeted surveys.

Communities

A total of 26.859 hectares of the nationally significant NTGVVP was mapped in habitat zone PG2 within the NGGA study area. This habitat zone also meets the description of the State significant [listed under the *Flora and Fauna Guarantee Act 1988* (FFG Act)] ecological community *Western (Basalt) Plains Grassland*. An additional 132.71 hectares of this FFG Act-listed community was mapped (i.e. habitat zone PG1) across the NGGA study, although this area does not meet the condition thresholds to constitute NTGVVP.

A summary of the ecological values recorded within the study area is provided in Table S1.

Port Phillip (Western Shoreline) and Bellarine Peninsula Ramsar Site

The nearest Ramsar wetland is the Port Phillip (Western Shoreline) and Bellarine Peninsula, approximately 4.5 kilometres to the east of the NGGA, with the Moorabool River complex ultimately flowing into Lake Connewarre - part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site approximately 14 kilometres to the south-east of the WGGA.

The NGGA comprises a large part of the Hovells Creek catchment which flows into the Point Wilson/ Limeburners Bay area of the Ramsar site, while the WGGA is located within the Moorabool River catchment, which subsequently feeds into the Barwon River and into the Lake Connewarre Ramsar complex. The Lake Connewarre complex is a saline environment sensitive to increases in freshwater flows.

Further investigations to understand the current volume and timing of existing flows into the Ramsar site from the NWGGA will need to be undertaken to allow the consideration of the potential ecological changes to the character of the Ramsar site that could potentially result from alterations to pre-development flows, and further determine how these changes can be appropriately minimised.

Table S1. Summary of the ecological values that occur within the assessed areas of the NWGGA.

Species diversity	Moderate assemblage of plants and animals, with 84 flora species and 75 fauna species recorded during the ecological surveys.

Native vegetation	**WGGA**
	• 69.379 hectares of native vegetation represented by three EVCs:
	  ○ *Low Rainfall* Plains Grassland (EVC 132_63) 41.479 hectares;
	  ○ Creekline Grassy Woodland (EVC 68) 4.859 hectares;
	  ○ Floodplain Riparian Woodland (EVC 56) 23.107 hectares;
	• 102 Large Trees in patches;
	• 2 Large Scattered River Red-gum *Eucalyptus camaldulensis*.
	NGGA
	• 155.906 hectares of remnant vegetation represented by one EVC and one DELWP modelled wetland:
	  ○ *Low Rainfall* Plains Grassland (EVC 132_63) 153.647 hectares;
	  ○ Current Wetlands (DELWP) 2.259 hectares.
	• Three Scattered Trees (one Large) Grey Box *Eucalyptus microcarpa*

Wetlands	• The NGGA site is approximately 4.5 kilometres west of Limeburners Bay – a part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site. • The Moorabool River system (western boundary of the WGGA) flows into Lake Connewarre - part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site.
Significant ecological communities	• A total of 26.859 hectares of the nationally significant ecological community *Natural Temperate Grassland of the Victorian Volcanic Plain* is present in the study area • A total of 132.71 hectares of the *Western (Basalt) Plains Grassland Community* is present in the study area (Figure 2)

Significant flora species	• No nationally significant flora were recorded in the study area.
	  ○ Assumed presence of Adamson's Blown-grass *Lachnagrostis adamsonii* within suitable habitat adjacent to Cowies Creek in the WGGA.
	• One State significant flora was recorded within the study area:
	  ○ Leafless Bluebush *Maireana aphylla*

Significant fauna species	• Known presence of three nationally significant fauna: ○ Confirmed presence of an important population of Growling Grass Frog along the Cowies Creek corridor;

	○ 187.49 hectares of suitable habitat for Striped Legless Lizard within the NGGA; ○ 693.69 hectares of confirmed habitat for Golden Sun Moth within the NGGA. • Known presence of one State significant fauna: ○ Platypus *Ornithorhynchus anatinus.* • Known presence of two Regionally significant fauna: ○ Eastern Long-necked Turtle *Chelodina longicollis;* ○ Spotted Harrier *Circus assimilis.*

CONTENTS

CONTENTS 11
1 INTRODUCTION 15
1.1 Background 15
1.2 Objectives 15
1.3 Study Area 16
1.3.1 Northern Geelong Growth Area (NGGA) 16
1.3.2 Western Geelong Growth Area (WGGA) 17
2 METHODS 19
2.1 Nomenclature 19
2.2 Desktop Assessment 19
2.2.1 Review of previous ecological assessments 21
2.3 Field Assessments 22
2.3.1 Ecological Assessment (including Habitat Hectare Assessment) 25
2.3.2 Targeted Flora Surveys 28
2.3.3 Targeted Fauna Surveys 34
2.4 Likelihood of Occurrence Assessment 44
2.5 Assessment Qualification and Limitations 45
2.5.1 Access Constraints 46
2.5.2 Spiny Rice-flower 47
2.5.3 Striped Legless Lizard Surveys 47
2.5.4 Golden Sun Moth 47
2.5.5 General Limitations 48
3 EXISTING ENVIRONMENT 50
3.1 Ecological Values 50
3.1.1 Overview 50
3.1.2 Native Vegetation 54
3.1.3 Fauna Habitat 59
3.2 Nationally Significant Values 62
3.2.1 Flora 62
3.2.2 Fauna 66

3.2.3 Ecological Communities 81
3.2.4 Migratory Species 82
3.2.5 Ramsar Sites 82
3.2.6 Other Matters of NES 83
3.3 State Significant Values 83
3.3.1 Flora 83
3.3.2 Fauna 85
3.3.3 Vegetation Communities 86
3.4 Regionally Significant Features 86
4 LEGISLATIVE AND POLICY IMPLICATIONS 87
4.1 *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) 87
4.1.1 Implications For Confirmed Matters Of National Environmental Significance 88
4.1.2 EPBC Act Assessment Process 93
4.2 Commonwealth Offset Implications 95
4.3 *Environment Effects Act 1978* (Victoria) 96
4.3.1 Implications 96
4.4 Planning and Environment Act 1987 96
4.4.1 Native Vegetation Precinct Plan 96
4.5 *Flora and Fauna Guarantee Act 1988* (Victoria) 97
4.6 *Flora and Fauna Guarantee Act Amendment Act 2019* (Victoria) 97
4.6.1 Implications 97
4.7 *Catchment and Land Protection Act 1994* (Victoria) 98
4.8 *Wildlife Act 1975* and Wildlife Regulations 2013 (Victoria) 98
5 MITIGATION MEASURES 99
5.1 Precinct Design Principles 99
5.2 Best Practice Mitigation Measures 100
5.3 Specific Mitigation Measures 101
5.3.1 Protection of Retained Ecological Values 101
5.3.2 Creation of Conservation Reserves and Biolinks 102
5.3.3 Revegetation and Enhancement 103
5.3.4 Habitat Creation 105
5.3.5 Riparian Corridor Enhancement 105

6 SUMMARY OF ECOLOGICAL FEATURES 108
6.1 Flora 108
6.2 Fauna 108
6.2.1 Striped Legless Lizard 109
6.2.2 Growling Grass Frog 109
6.2.3 Golden Sun Moth 110
6.2.4 Australian Grayling and Little Galaxias 110
6.3 Communities 110
6.3.1 Natural Temperate Grassland of the Victorian Volcanic Plain 110
6.3.2 Western (Basalt) Plains Grassland 111
7 RECOMMENDATIONS 113
7.1 Unassessed Areas 113
7.2 Port Phillip (Western Shoreline) and Bellarine Peninsula Ramsar Site 113
7.3 Current Wetlands 114
REFERENCES 116
FIGURES 123
APPENDICES 153
APPENDIX 1 154
Appendix 1.1 – Rare or Threatened Categories for Listed Victorian Taxa 154
Appendix 1.2 – Defining Ecological Significance 155
Appendix 1.3 – Defining Site Significance 156
Appendix 1.4 – Vegetation Condition and Habitat Quality 157
Appendix 1.5 – *Flora and Fauna Guarantee Act 1988* Protected Species 158
APPENDIX 2 - FLORA 159
Appendix 2.1 – Flora Results 159
Appendix 2.2 – Significant Flora 164
Appendix 2.3 – Habitat Hectare Assessment 170
Appendix 2.4 – Scattered Trees and Large Trees in Patches 171
Appendix 2.5. Summary of Spiny Rice-Flower Targeted Survey Results 176
APPENDIX 3 - FAUNA 177
Appendix 3.1 – Fauna Results 177
Appendix 3.2 – Significant Fauna Species 181

Appendix 3.3 – Fauna Species Detected during Targeted Australian Grayling Surveys along the Moorabool River 189

APPENDIX 4 – FAUNA SURVEY DATA 192

Appendix 4.1 – Striped Legless Lizard Survey Data 2020/2021 192

Appendix 4.2 – Striped Legless Lizard Survey Data 2020/2021 - WGGA 207

1 INTRODUCTION

1.1 Background

Ecology and Heritage Partners Pty Ltd was commissioned by the City of Greater Geelong (herein referred to as CoGG) to undertake a suite of detailed ecological investigations within two separate study areas identified as the Western Geelong Growth Area (WGGA) and the Northern Geelong Growth Area (NGGA) (Figure 1).

Both the WGGA and NGGA were identified in the G21 Regional Growth Plan (G21 Geelong Region Alliance 2013) as being potentially suitable for development aimed at accommodating the medium, and longer-term growth of Geelong. In late 2015, CoGG committed to developing an Integrated Infrastructure Delivery Plan (IIDP) and Framework Plan for the Western and Northern Further Investigation areas.

The findings presented herein will be used by the CoGG to inform decisions regarding the future planning and development of six precinct structure plans (PSPs) within the study area, and in particular, guide the CoGG in determining the location and extent of native vegetation and fauna habitat that will be retained and removal as part of the future development of the precincts. This information will be used by the successful contractor to prepare six Native Vegetation Precinct Plans (NVPPs), including the initial two PSPs, Elcho Road East PSP (NGGA) and Creamery Road PSP (WGGA) over the next two years.

In addition, the findings outlined in this report will be used as part of any necessary approvals under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1.2 Objectives

The objective of this report is to inform decisions regarding the future planning and development of six Precinct Structure Plans (PSPs) within the NGGA and WGGA. The information presented in this report is based on a detailed desktop review and field assessment of accessible land within the study area undertaken between November 2019 and December 2020. Specifically, the following have been undertaken as part of the project:

- Identification, assessment, and mapping of areas supporting native vegetation and fauna habitat, including a determination of conservation significance;
- Data collection at sufficient detail and standard that enables a biodiversity assessment and associated NVPPs to be prepared in accordance with DELWP's – *Preparing a Native Vegetation Precinct Plan* (DELWP 2017a)
- Collection and presentation of biodiversity values to allow integration with the planning and development of each precinct;
- Provision of management measures that should be implemented to reduce adverse impacts on biodiversity values known to, or likely to occur in the precincts; and,
- Identify areas of degraded vegetation that are likely to support suitable habitat for significant species that may be suitable for retention and management in the future.

1.3 Study Area

1.3.1 Northern Geelong Growth Area (NGGA)

The NGGA covers approximately 2,245 hectares of land bound by Staceys Road to the north, Geelong-Bacchus Marsh Road to the east, the Geelong Ring Road to the south-east, Anakie Road to the south-west, and private rural land to the west (Figure 1).

According to the Victorian Department of Environment, Land, Water and Planning (DELWP) NatureKit Map (DELWP 2021b), the NGGA occurs within the jurisdiction of the Corangamite Catchment Management Authority (CMA) and the CoGG municipality. The NGGA extends over a single bioregion, the Victorian Volcanic Plain bioregion.

There are currently multiple land use zones across the NGGA. The largest percentage is Urban Growth Zone (UGZ), occupying the northern and western sections of the NGGA. The second largest area is Rural Land Zone (RLZ) in the southern and eastern sections. Other zones include Public Use Zone (PUZ) at the Lovely Banks Basins along Anakie Road and Farming Zone (FZ) occupying the land along the western and north-western boundaries.

The NGGA is characterised primarily by the Lovely Banks escarpment, which cuts from north-east to south-west through the eastern section of the NGGA. The land is largely open, treeless pasture, primarily used for pastoral and cropping activities in conjunction with rural residential housing. There are several ephemeral drainage lines and farm dams which occur within NGGA. There are no Ramsar or nationally significant wetlands mapped within the NGGA. However, overland flows including ephemeral drainage lines discharge into Corio Bay, which includes part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site along the north-eastern shore and extending to the outer harbour (DELWP 2021c).

Properties where access was not permitted during on-ground assessments are listed below (Table 1).

Table 1. Parcels where site access was not permitted within the NGGA.

Parcel #	Property Address	Parcel #	Property Address
1	970 Anakie Road, Lovely Banks 3213	11	50 McNeill Court, Lara, 3212
2	930 Anakie Road, Lovely Banks 3213	12	60 McNeill Court, Lara, 3212
3	810-870 Anakie Road, Lovely Banks 3213	13	80 McNeill Court, Lara, 3212
4	780 Anakie Road, Lovely Banks 3213	14	20 McNeill Court, Lara, 3212
5	700 Anakie Road, Lovely Banks 3213	15	10 McNeill Court, Lara, 3212
6	285-295 Emmersons Road, Lovely Banks 3213	16	45 Oswald Avenue, Lara, 3212
7	410 Houston Road, Lara 3212	17	35 Oswald Avenue, Lara, 3212
8	110 Houston Road, Lara 3212	18	30 Oswald Avenue, Lara, 3212
9	100 Houston Road, Lara 3212	19	645 Bacchus Marsh Road, Lovely Banks, 3212
10	90 Houston Road, Lara 3212		

The extent of parcels not assessed (as shown in Figure 2) comprises 754.821 hectares, equating to approximately 33.6% of the NGGA.

1.3.2 Western Geelong Growth Area (WGGA)

The WGGA (as defined for the purposes of this assessment, and shown in Figure 1 and Figure 3) covers approximately 770 hectares of land inclusive of the Batesford, Moorabool, and Bell Post Hill areas. The WGGA extends between the Midland Highway to the south, the Geelong Ring Road to the east, the Moorabool River in the west, and the Ballarat-Geelong Rail line in the north (Figure 1).

According to DELWP's NatureKit (DELWP 2021b), the WGGA occurs within the jurisdiction of the Corangamite Catchment Management Authority (CMA) and the CoGG municipality. The WGGA extends over a single bioregion (the Victorian Volcanic Plain) and under the CoGG Planning Scheme the following zones and overlays cover the WGGA:

- Planning Zones: Farming Zone (FZ), Special Use Zone 15 (SUZ15), Rural Living Zone (RLZ), Public Park and Recreation Zone (PPRZ), Road Zone 1 (RDZ1), Township Zone (TZ), Low Density Residential Zone (LDRZ), Public Conservation and Resource Zone (PCRZ) and Public Use Zone 4 (PUZ4).
- Planning Overlays (relating to ecological values): Environmental Significance Overlay Schedule 1 and Schedule 3 (ESO1, ESO3), Design and Development Overlay Schedule 14 (DDO14), Land Subject to Inundation Overlay (LSIO), Floodway Overlay (FO), Design and Development Overlay (DDO5), and Heritage Overlays HO35, HO1971, HO1970.

The range of zones applied to the WGGA are reflected by the mix of existing land uses that include agriculture, recreation reserves, conservation reserves, rural and medium density housing, and educational facilities.

The WGGA does not contain any formal conservation reserves managed by Parks Victoria; however a number of Council-managed reserves are present, including the Moorabool River Reserve. In addition, some Crown Land reserves run through the WGGA, largely associated with Crown water frontages, as well as road reserves, several of which support native vegetation.

There are no Ramsar or nationally significant wetlands mapped within the WGGA, although the Moorabool River system flows into Lake Connewarre further downstream, which is a part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. Farm dams are also present throughout the site.

Properties where access was not permitted during on-ground assessments are listed below (Table 2).

Table 2. Parcels where site access was not permitted within the WGGA.

Parcel #	Property Address	Parcel #	Property Address
1	35-45 Old Ballarat Road Batesford 3213	17	60 Pennsylvania Avenue Batesford 3213
2	10 Palmerston Street Batesford 3213	18	25 Lynnburn Road Batesford 3213
3	Ross Road Batesford 3213	19	45 Lynnburn Road Batesford 3213
4	30 Bridge Street Batesford 3213	20	535 Ballarat Road Batesford 3213
5	10 Lynnburn Road Batesford 3213	21	5 Lynnburn Road Batesford 3213
6	20 Avonlea Road Bell Post Hill 3215	22	15 Lynnburn Road Batesford 3213
7	20 Avonlea Road Bell Post Hill 3215	23	30 Lynnburn Road Batesford 3213
8	20 Bridge Street Batesford 3213	24	50 Lynnburn Road Batesford 3213
9	100 Palmerston Street Batesford 3213	25	485 Ballarat Road Batesford 3213

Parcel #	Property Address	Parcel #	Property Address
10	55 Pennsylvania Avenue Batesford 3213	**26**	10 Ross Road Batesford 3213
11	45 Pennsylvania Avenue Batesford 3213	**27**	20 Ross Road Batesford 3213
12	35 Pennsylvania Avenue Batesford 3213	**28**	22 Ross Road Batesford 3213
13	10 Pennsylvania Avenue Batesford 3213	**29**	475 Ballarat Road Batesford 3213
14	20 Pennsylvania Avenue Batesford 3213	**30**	465 Ballarat Road Batesford 3213
15	30 Pennsylvania Avenue Batesford 3213	**31**	25 Ballan Road Batesford 3213
16	40 Pennsylvania Avenue Batesford 3213	**32**	341-345 Ballarat Road Batesford 3213

The extent of parcels not assessed (as shown in Figure 3) comprises 100.85 hectares, equating to approximately 13.1% of the WGGA.

2 METHODS

This chapter details the desk-based and field methods used in surveying the current environment as well as the methods used to assess the likelihood of significant flora and fauna species occurring within the NWGGA, including how the survey effort, design and methodology for each of the relevant ecological values are informed by Commonwealth and Victorian flora and fauna survey guidelines. It is noted that the methodology detailed below is in accordance with the standard ecological assessment requirements used to inform the precinct structure planning process.

2.1 Nomenclature

Common and scientific names of vascular plants follow the Victorian Biodiversity Atlas (VBA) (DELWP 2021a) and the Census of Vascular Plants of Victoria (Walsh and Stajsic 2007). Vegetation community names follow DELWP's EVC benchmarks (DELWP 2021c). The names of aquatic and terrestrial vertebrate and invertebrate fauna follow the VBA (DELWP 2021a).

2.2 Desktop Assessment

Relevant literature, online-resources and databases were reviewed to provide an assessment of flora and fauna values associated with the NWGGA. The following information sources were reviewed:

- The DELWP NatureKit Map (DELWP 2021c) for:
- Modelled data for location category, remnant vegetation patches, scattered trees and habitat for rare or threatened species;
- The extent of historic and current EVCs;
- Previously documented flora and fauna records within the project locality
- The Victorian Biodiversity Atlas (VBA) (DELWP 2021a); and Atlas of Living Australia (ALA) (ALA 2021) for previously documented flora and fauna records within the project locality
- The Atlas of Living Australia (ALA) (ALA 2021) for assistance with the distribution and identification of flora species
- EVC benchmarks (DELWP 2021c) for descriptions of EVCs within the Victorian Volcanic Plain and Otway Plain bioregions;
- VicPlan Online (DELWP 2021e) to ascertain current zoning and environmental overlays in the NWGGA;
- The Illustrated Flora Information System of Victoria (IFLISV) (Gullan 2017) for assistance with the distribution and identification of flora species;
- The Commonwealth Department of Agriculture Water and the Environment (DAWE) Protected Matters Search Tool (PMST) for matters of National Environmental Significance (NES) protected under the EPBC Act (DAWE 2021);

- Relevant listings under the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act), including the latest Threatened and Protected Lists (DELWP 2019a; 2021f);
- Aerial photography of the NWGGA;
- The Northern and Western Geelong Growth Areas Framework Plan – August 2020 (CoGG 2020);
- Previous ecological reports within or adjacent to the NWGGA, including:
    - Mark Trengrove Ecological Services 2016. 225 Staceys Road Lovely Banks, Vegetation and Biodiversity Assessment Report.
    - Ecology and Heritage Partners Pty Ltd 2016. City of Greater Geelong – Assessment of Biodiversity Assets of Roadsides.
    - Ecology and Heritage Partners Pty Ltd, December 2015. Preliminary vegetation and threatened flora and fauna habitat assessment for the Lovely Banks Urban Growth Zone;
    - Ecology Partners Pty Ltd 2008. Overview of ecological values of the 'Wider Study Area', Lovely Banks, Victoria.
    - Ecology and Heritage Partners Pty Ltd 2017a. Flora and Fauna Technical Report: Northern Geelong Growth Area.
    - Ecology and Heritage Partners 2017b. Flora and Fauna Technical Report: Western Geelong Growth Area.
- Relevant environmental legislation and policies pertaining to target species including EPBC Act Policy Statements, FFG Act Action Statements, National Recovery Plans, Advisory Lists, including;
    - DEWHA 2009a. Significant impact guidelines for the critically endangered spiny rice-flower (*Pimelea spinescens* subsp. *spinescens*);
    - DEWHA 2009b. Significant impact guidelines for the critically endangered Golden Sun Moth (*Synemon plana*);
    - DEWHA 2009c. 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*);
    - DEWHA 2009d. Significant impact guidelines for the vulnerable growling grass frog (*Litoria raniformis*);
    - DEWHA 2010. Survey Guidelines for Australia's threatened frogs. Guidelines for detecting frogs listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999*;
    - DoE 2013. Significant Impact Guidelines 1.1. Matters of National Environmental Significance. Commonwealth Department of the Environment, Canberra, ACT.
- DSEWPaC 2011a. *Environment Protection and Biodiversity Conservation Act 1999*. Referral guidelines for the vulnerable striped legless lizard, *Delma impar*;
- DSEWPaC 2011b. Survey Guidelines for Australia's threatened reptiles. Guidelines for detecting reptiles listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999;*

- DSEWPaC 2011c. Nationally Threatened Ecological Communities of the Victorian Volcanic Plain: Natural Temperate Grassland and Grassy Eucalypt Woodland A guide to the identification, assessment and management of nationally threatened ecological communities *Environment Protection and Biodiversity Conservation Act 1999*;
- DSEWPaC 2011d. Survey guidelines for Australia's threatened fish: Guidelines for detecting fish listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999*;
- Robertson and Evans 2009. National Recovery Plan for the Grassland Earless Dragon *Tympanocryptis pinguicula*;
- TSSC 2008. Commonwealth Listing Advice on Natural Temperate Grassland of the Victorian Volcanic Plain; and,
- TSSC 2012. Commonwealth Listing Advice on Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains.

2.2.1 Review of previous ecological assessments

Several ecological assessments have previously been undertaken within the western and northern Geelong locality that describe the ecological values present, or that are considered likely to occur. The following summarises the key ecological implications and scope of the assessments outlined in their previous assessments (Table 3):

Table 3. Previous assessments completed within the NWGGA.

Report Title	Scope	Summary of findings
225 Staceys Road Lovely Banks, Vegetation and Biodiversity Assessment Report (Mark Trengrove Ecological Services, June 2016)	The assessment focussed on a 32 hectare study area encompassing the property at 225 Staceys Road Lovely Banks (Figure 2). A detailed desktop review was undertaken and detailed vegetation surveys (including habitat hectare surveys) were conducted on 27 April 2015.	A small area (0.101 hectares) of Plains Grassland EVC was recorded. No matters of NES were considered likely to occur.
City of Greater Geelong – Assessment of Biodiversity Assets of Roadsides (Ecology and Heritage Partners Pty Ltd 2016)	Ecology and Heritage Partners Pty Ltd was commissioned by CoGG to conduct an assessment of biodiversity assets on Roadsides within the City of Greater Geelong municipality. The purpose of the assessment was to identify the extent, type and quality of remnant native vegetation present on Council managed roadsides.	No nationally significant flora or fauna were recorded. However, there is considered to be suitable habitat for several species. Six State significant flora were recorded, with additional species considered likely to occur. Two nationally significant, and three State significant ecological communities were present.
Preliminary vegetation and threatened flora and fauna habitat assessment for the Lovely Banks Urban Growth Zone, Lovely Banks, Victoria (Ecology and Heritage Partners Pty Ltd, December 2015)	Preliminary vegetation and fauna habitat assessments were undertaken in July 2015 within areas totalling 1,285 hectares associated with the Lovely Banks Development Group.	The site was generally dominated by Chilean Needle-grass *Nassella neesiana*, with Plains Grassland EVC also present ranging from poor to moderate condition. Higher quality areas met the condition thresholds for the nationally significant NTGVVP ecological community. There was considered to be a moderate likelihood of occurrence for Spiny Rice-flower, Large-headed Fireweed, Striped Legless Lizard and Golden Sun Moth.

Report Title	Scope	Summary of findings
Overview of ecological values of the 'Wider Study Area', Lovely Banks, Victoria (Ecology Partners Pty Ltd 2008)	The overview assessment involved two components, a desktop review of existing ecological data and a field inspection throughout the Lovely Banks area. The study area was located between the existing residential development of Lovely Banks in the south and east, and Elcho Road in the north and Evans Road in the west. A small parcel of land was also inspected to the west of Bacchus-Marsh Road and south of Staceys Road.	The study area supported little intact native vegetation due to agricultural practices, and the ongoing drought conditions. There was considered to be a low likelihood of occurrence for nationally significant flora and fauna based on the roadside inspection of private property. However, further on-ground assessments were recommended to confirm the findings of the desktop assessment.
Flora and Fauna Technical Report: Northern Geelong Growth Area (Ecology and Heritage Partners 2017a)	Detailed desktop review and inspections of accessible land covering 53% of the NGGA. The report provides an overview of the biodiversity values and key assets within the NGGA to guide suitable planning and conservation objectives within the future development precinct. The results of this report has directed targeted surveys completed within this Biodiversity Assessment Report.	Several patches of Plains Grassland, including some that qualified as the NTGVVP community were present. Further mapping was required to refine the extent of some patches. The NGGA supported habitat for the nationally significant Spiny Rice-flower and Large-headed Fireweed, as well as Golden Sun Moth and Striped Legless Lizard.
Flora and Fauna Technical Report: Western Geelong Growth Area (Ecology and Heritage Partners 2017b).	Detailed desktop review and inspections of accessible land undertaken in August and September 2016 of the broader WGGA study area. The report provides an overview of the biodiversity values and key assets within the WGGA to guide suitable planning and conservation objectives within the future development precinct. The results of this report directed targeted surveys completed within this Biodiversity Assessment Report.	Discrete patches of Plains Grassland were recorded, which were also considered to be potential habitat for four nationally significant flora (Matted Flax-lily, Spiny Rice-flower, Large-headed Fireweed and Button Wrinklewort), as well as several State significant flora. Habitat for the nationally significant fauna Golden Sun Moth, Striped Legless Lizard, Australian Grayling and Growling Grass Frog was also present in these areas. Habitat for several additional significant fauna species is present within the broader locality.

2.3 Field Assessments

The ecological field assessment program detailed in this report was completed by qualified ecologists within the WGGA and NGGA between 1 November 2019 and 27 December 2020. The field assessments sought primarily to assess the extent and condition of native vegetation communities and potential flora and fauna habitat, with particular consideration given to significant ecological communities and species of conservation concern, such as threatened and migratory species. The survey program was designed to optimise the survey timing, methods and frequency to enable sampling of those flora and fauna species which occur seasonally.

All fieldwork was carried out under the appropriate licences, including a Research Permit (1008283) and Scientific Procedures Fieldwork Licence (SPFL20005) issued by DELWP under the *Wildlife Act 1975*, and an Animal Research permit issued by the Wildlife and Small Institutions Animal Ethics Committee (05.17).

The timing and extent of each survey event is summarised below (Table 4). Over 200 person days (excluding travel) was undertaken as part of the ecological surveys across the NWGGA.

For the purposes of this report, the 'study area' refers to areas within the NWGGA that were subject to the on-ground assessments. As such, the results of the field assessments, presence of habitats and associated

implications detailed in this report relate only to the areas that were subject to the on-ground assessments (unless specifically indicated otherwise). These areas are shown in Figures 2 and 3.

Table 4. Survey schedule for the ecological assessment program.

Ecological Value	Species / Community	Survey Dates	Resources	Location *
Threatened Ecological Communities	NTGVVP Ecological Community	1 November 2019 (WGGA) 13-14 November 2019 (NGGA) 25 November 2019 (NGGA) 5-6 December 2019 (NGGA) 21 January 2020 (WGGA)	4 x ecologists	Throughout study areas Figure 2 and 3.
Threatened EPBC Act Fauna Species	Striped Legless Lizard *Delma impar* (Tile Checks)	2019/20 Surveys 27 grids x 8 surveys = 216 tile checks between 5 December 2019 and 28 February 2020 2020/21 Surveys 77 grids x 8 surveys = 616 tile checks between 29 September and 30 November 2020 ^	4 x ecologists	Figure 4a and 4b.
	Growling Grass Frog *Litoria raniformis*	13 December 2019 (Moorabool River) 26,28 February 2020 (Moorabool River) 06 December 2019 (Cowies Creek) 12 January 2020 (Cowies Creek)	2 x ecologists	Moorabool River and Cowies Creek Figure 4b.
	Golden Sun Moth *Synemon plana*	2019/20 Surveys Surveys completed between 5 December 2019 and 29 January 2020 2020/21 Surveys Survey completed between 27 November and 27 December 2020+	4-8 x ecologists	Figure 4a and 4b.
	Australian Grayling and Little Galaxias *Galaxiella toourtkoourt*	11-12 December 2019 (Moorabool River/WGGA) 28-29 January 2020 (Cowies Creek/WGGA	2 x ecologists	Moorabool River, Cowies Creek Figure 4b
Threatened EPBC Act Flora Species	Large-headed Fireweed *Senecio macrocarpus*	1 November 2019 (WGGA) 13-14 November 2019 (NGGA) 25 November 2019 (NGGA) 5-6 December 2019 (NGGA)	2 x ecologists	Figure 5a and Figure 5b
	Matted Flax-lily *Dianella amoena*	1 November 2019 (WGGA) 13-14 November 2019 (NGGA) 25 November 2019 (NGGA) 5-6 December 2019 (NGGA) 19 December 2019 (WGGA) 21 January 2020 (WGGA) 5 February 2020 (WGGA)	2 x ecologists	Figure 5a and Figure 5b

Ecological Value	Species / Community	Survey Dates	Resources	Location *
	Clover Glycine *Glycine latrobeana*	1 November 2019 (WGGA) 13-14 November 2019 (NGGA) 25 November 2019 (NGGA) 5-6 December 2019 (NGGA)	2 x ecologists	Figure 5a and Figure 5b
	Button Wrinklewort *Rutidosis leptorhynchoides*	1 November 2019 (WGGA) 13-14 November 2019 (NGGA) 25 November 2019 (NGGA) 5-6 December 2019 (NGGA 19 December 2019 (WGGA) 21 January 2020 (WGGA) 5 February 2020 (WGGA))	2 x ecologists	Figure 5a and Figure 5b
	Adamson's Blown-grass *Lachnagrostis adamsonii*	5-6 December 2019 (NGGA) 19 December 2019 (WGGA) 21 January 2020 (WGGA) 5 February 2020 (WGGA)	4 x ecologists	Figure 5a and Figure 5b
	Spiny Rice-flower *Pimelea spinescens* subsp. *spinescens*	23 July 2020 (NGGA) 27-30 July 2020 (NGGA) 3-6 August 2020 (WGGA) 10, 12-14 August 2020 (NGGA) 18-19 August 2020 (NGGA) 20-21 August 2020 (WGGA) 24-26 August 2020 (NGGA) 27 August 2020 (WGGA)	4-6 ecologists	Figure 5a and Figure 5b
FFG Act and VROT Flora	Acacias	1 November 2019 (WGGA) 13-14 November 2019 (NGGA) 25 November 2019 (NGGA) 5-6 December 2019 (WGGA) 21 January 2020 (WGGA)	4 x ecologists	Throughout
	Daisies	1 November 2019 (WGGA) 13-14 November 2019 (NGGA) 25 November 2019 (NGGA) 5-6 December 2019 (WGGA) 21 January 2020 (WGGA)	4 x ecologists	Throughout
	Orchids	1 November 2019 (WGGA) 13-14 November 2019 (NGGA) 25 November 2019 (NGGA) 5-6 December 2019 (WGGA) 21 January 2020 (WGGA)	4 x ecologists	Throughout
FFG Act and VROT Fauna	Tussock Skink *Pseudemoia pagenstecheri*	2019/2020 Surveys Between 5 December 2019 and 28 February 2020 2020/2021 Surveys Between 29 September and 30 November 2020 ^	2 x ecologists	Figure 4a and Figure 4b.

Ecological Value	Species / Community	Survey Dates	Resources	Location *
	Western (Basalt) Plains Grassland	1 November 2019 (WGGA) 13-14 November 2019 (NGGA) 25 November 2019 (NGGA) 05-06 December 2019 (NGGA) 21 January 2020 (WGGA)	4 x ecologists	Throughout. See Figures 2 and 3.
Habitat Hectare Assessment	Patches of Native Vegetation, Large Trees and Scattered Trees	1 November 2019 (WGGA); 13-14 November 2019 (NGGA); 25 November 2019 (NGGA); 5-6 December 2019 (NGGA); 21 January 2020 (WGGA).	VQA Methodology	Throughout. See Figures 2 and 3.
Aquatic Assessment	Australian Grayling	11-12 December 2019 (Moorabool River/WGGA) 28-29 January 2020 (Cowies Creek/WGGA	2 x ecologists	Moorabool River, Cowies Creek (WGGA)

Note: * Except the areas where access was denied**; ^** Specific dates provided in Appendix 4**; +** Specific dates provided in Table 25**.**

2.3.1 Ecological Assessment (including Habitat Hectare Assessment)

Detailed ecological assessments were undertaken by botanists accredited by DELWP in the habitat hectare methodology (DSE 2004) to quantify the quality and extent of native vegetation values within the NWGGA, identify flora and fauna habitat values within the NWGGA, and to determine conditions with reference to findings of the desk-based assessment.

The study areas were walked and/or driven, with all observed vascular flora and fauna species recorded, any significant records mapped and the overall condition of vegetation and habitats noted. Native vegetation in the local area was also investigated to assist in determining the pre-European vegetation within the NWGGA. Ecological Vegetation Classes were determined with reference to DELWP pre-1750 and extant EVC mapping (DELWP 2021b) and their published descriptions (DELWP 2021c).

The surveys sought primarily to assess the extent and condition of native vegetation communities and potential flora and fauna habitat, with consideration given to significant ecological communities and species of conservation concern, such as threatened and migratory species.

The study area was visually assessed and active searching under and around ground debris for reptiles, frogs and small mammals was undertaken. Binoculars were also used to scan the area for birds, and observers listened for calls and searched for other signs of fauna such as nests, remains of dead animals, droppings and footprints. Potential habitat for fauna was assessed, with an emphasis on waterbodies such as Cowies Creek and the Moorabool River, as well as grassland habitats that may provide shelter, food or other resources for significant species.

Assessments were made on foot by walking into the areas considered likely to support the highest-quality and representative habitat (judgement based on the outcomes of the desktop assessment, aerial imagery and prior field experience). Zoologists remained adaptable in the field, and opportunistically included other nearby areas in the investigation if those areas were thought to provide higher quality habitat or help provide information on fauna species that might use habitat within the NGGA and/or WGGA. Photographs were taken

at locations as a record of the habitats encountered. Observations of threatened species were recorded at locations if seen/heard.

As outlined above, where native vegetation was identified, a habitat hectare assessment was undertaken following the methods described in the Vegetation Quality Assessment Manual (DSE 2004), with the results provided in Appendix 2.3.

Native vegetation was classified in accordance with the definitions provided in Table 5, as defined in the '*Guidelines for the removal, destruction or lopping of native vegetation'* (the Guidelines) (DELWP 2017b).

In summary, the following tasks were undertaken as part of the field assessments within the NWGGA:

- The identification of flora and fauna habitat values;
- An assessment of all watercourses, wetlands and springs;
- An assessment of all potential native fauna habitat, including habitat corridors, food and water sources, nesting and foraging sites;
- The identification of all native vegetation, including:
    - EVCs;
    - Scattered trees, with Diameter and Breast Height (DBH) quantified, and trees identified as Large Trees or Small Trees;
- Identify the potential presence of any Matters of National Environmental Significance (NES) listed under the EPBC Act;
- A habitat hectares assessment of the native vegetation within the study area, in accordance with the Vegetation Quality Assessment Manual (DSE 2004);
- The documentation of site and vegetation information, including the address of the property; and,
- photographs of the native vegetation within the study area;

2.3.1.1 Removal, Destruction or Lopping of Native Vegetation (the Guidelines)

Under the *Planning and Environment Act 1987*, Clause 52.17 of the Planning Schemes requires a planning permit from the relevant local Council to remove, destroy or lop native vegetation. The assessment process for the clearing of vegetation follow the '*Guidelines for the removal, destruction or lopping of native vegetation*' (the Guidelines) (DELWP 2017b)

Vegetation Assessment

Native vegetation as defined in the Guidelines (DELWP 2017b) (Table 5) is assessed using two key parameters: extent (in hectares) and condition. For the purposes of this assessment, both condition and extent were determined as part of the field assessments.

In addition, the type and general condition of all vegetation was assessed and a determination made as to whether it qualifies for further consideration under local, State or national legislation and policy.

Table 5. Determination of native vegetation (DELWP 2017b).

Category	Definition	Extent	Condition
Patch of native vegetation	An area of vegetation where at least 25 per cent of the total perennial understorey plant cover is native; OR An area with three or more native canopy trees where the drip line of each tree touches the drip line of at least one other tree, forming a continuous canopy; OR Any mapped wetland included in the *Current Wetlands map*, available in DELWP systems and tools.	Measured in hectares. Based on hectare area of the patch.	Vegetation Quality Assessment Manual (DSE 2004). Modelled condition for *Current Wetlands*.
Scattered tree	A native canopy tree that does not form part of a remnant patch.	Measured in hectares. Each Large scattered tree is assigned an extent of 0.071 hectares (30m diameter). Each Small scattered tree is assigned a default extent of 0.31 hectares (10 metre diameter)	Scattered trees are assigned a default condition score of 0.2 (outside a patch).

Notes: Native vegetation is defined in the Victoria Planning Provisions as 'plants that are indigenous to Victoria, including trees, shrubs, herbs and grasses'.

Assessment Pathway

The Guidelines manage the impacts on biodiversity from native vegetation removal using an assessment-based approach. Two factors – extent and location – are used to determine the assessment pathway associated with an application for a permit to remove native vegetation. The location category (1, 2 or 3) has been determined for all areas in Victoria and is available on DELWP's NatureKit Map (DELWP 2021c). Determination of the assessment pathway is summarised in Table 6.

Table 6. Assessment pathways for applications to remove native vegetation (DELWP 2017b)

Extent		Location		
		1	2	3
Native Vegetation	< 0.5 hectares, and not including any large trees	Basic	Intermediate	Detailed
	Less than 0.5 hectares, and including one or more large trees	Intermediate	Intermediate	Detailed
	0.5 hectares or more	Detailed	Detailed	Detailed

Notes: For the purpose of determining the assessment pathway of an application to remove native vegetation the extent includes any other native vegetation that was permitted to be removed on the same contiguous parcel of land with the same ownership as the native vegetation to be removed, where the removal occurred in the five year period before an application to remove native vegetation is lodged.

Current Wetlands (DELWP)

Wetlands can be difficult to map and assess accurately as they respond quite quickly to changes in environmental condition, especially rainfall. After a period of no or low rainfall they can disappear or appear very degraded. However, wetlands are known to rapidly recover when inundated after rainfalls. As a result, all DELWP mapped wetlands (based on 'Current Wetlands' layer in the DELWP NatureKit Map [DELWP 2021b])

that are to be impacted must be included as native vegetation, with the modelled condition score assigned to them (DELWP 2017b). Mapped wetlands within the NWGGA are shown in Figure 2.

Current Wetlands do not apply if they are covered by a hardened, man-made surface, for example, a roadway. If covered by any vegetation including crops, bare soil, a mapped wetland should be treated as a remnant patch. The mapped extent of Current Wetlands may be refined if supported by the outcome of a hydrological assessment and approved by DELWP.

Large Tree and Habitat Assessment

Large tree and habitat assessments were undertaken concurrently with the habitat hectare assessments to quantify the number of scattered trees and Large Trees within native vegetation, as well as to collate data pertaining to the presence of hollows and/or nests and significant 'habitat trees' that may provide habitat for fauna. Where present, hollows, nests or other relevant features were noted during the assessments.

Large Tree benchmarks relating to the potential EVCs present within the NWGGA are summarised below (Table 7).

Table 7. Benchmark sizes for large trees within the NWGGA.

EVC	Species	Large Tree (DBH)	Small Tree (DBH)
Creekline Grassy Woodland (EVC 68)	*Eucalyptus* spp.	≥ 80 cm	< 80 cm
Floodplain Riparian Woodland (EVC 56)	*Eucalyptus* spp.	≥ 80 cm	< 80cm

Note. DBH = Diameter at Breast Height (i.e. - 1.3 metres above ground level).

2.3.2 Targeted Flora Surveys

Based on the findings of the desktop assessment (Section 2.2), and previous recommendations outlined in the initial Biodiversity Assessments (Ecology and Heritage Partners 2017a, 2017b), targeted surveys for significant flora species were undertaken for six nationally significant flora species in the WGGA and NGGA between November 2019 and August 2020 (Table 8). Surveys were undertaken at this time to maximise the likelihood of detection of significant flora species identified as having the potential to occur within the NWGGA.

Table 8. Targeted flora species considered to have the highest likelihood of occurrence.

Common name	Species Name	Listing under EPBC Act	Optimal Survey Timing *
Large-headed Fireweed	*Senecio macrocarpus*	VU	September-November
Matted Flax-lily	*Dianella amoena*	EN	October-April
Clover Glycine	*Glycine latrobeana*	VU	September - December
Button Wrinklewort	*Rutidosis leptorhynchoides*	EN	October-February
Adamson's Blown-grass	*Lachnagrostis adamsonii*	EN	November -February
Spiny Rice-flower	*Pimelea spinescens* subsp. *spinescens*	CR	April – August

Note: * Optimal timing based on flowering season, or when the species can be reliably identified using other morphological features. CR = Critically Endangered, EN = Endangered, VU = Vulnerable.

2.3.2.1 Large-headed Fireweed

Large-headed Fireweed is an erect or sprawling subshrub listed as Vulnerable under the EPBC Act, listed under the Victorian FFG Act, and as endangered under the Advisory List of Rare and Threatened Plants in Victoria (DEPI 2014). The species is largely confined to Kangaroo Grass *Themeda triandra* grasslands on loamy clay soils derived from basalt (DAWE 2021a).

The species is a daisy that grows either as an erect long-lived herb or a small shrub (Plate 1). Each plant has 6–8 large yellowish flower-heads that are about 20 mm long and contain 50–100 individual flowers typically flowering between September – November (DAWE 2021a). The species has the potential to occur within areas of relatively undisturbed Plains Grassland with Kangaroo Grass present (DAWE 2021a).

Few areas of relatively undisturbed Plains Grassland supporting Kangaroo Grass was observed within both study areas. The dominant grassland species was Wallaby-grass often defined by the minimum 25% native perennial cover, which is not considered likely habitat for the species in combination with a lack of historical records.

No accessible reference sites within the locality were able to be visited prior to the targeted surveys. However, surveys were conducted by qualified ecologists who were familiar with the target species. Areas of high quality habitat (PG2, NTGVVP) and areas combining native vegetation and embedded rock were considered likely habitat for the species (Figure 4a; Figure 4b) and were traversed on foot, with surveys conducted along transect lines roughly five metres apart, or as dictated by the density of previous agricultural disturbance, existing grasses and weeds as per the recommended survey guidelines detailed in the Biodiversity Precinct Planning Structure Kit (DSE 2010).

The species was also a focus of detection during surveys 3 and 4 of the Golden Sun Moth surveys that were undertaken during the species 2019/20 and 2020/21 flight seasons. In these instances, up to six staff were on-site undertaking Golden Sun Moth surveys on foot. In areas of potential habitat, these surveys were conducted along five metre transects as per the recommended survey guidelines detailed in the Biodiversity Precinct Planning Structure Kit (DSE 2010).

2.3.2.2 Matted Flax-lily

Matted Flax-lily is listed as Endangered under the EPBC Act, listed as Threatened under the Victorian FFG Act, and as endangered under the Advisory List of Rare and Threatened Plants in Victoria (DEPI 2014). Matted Flax-lily is a perennial, tufted, mat-forming lily which can form patches of up to five metres wide. The plant can grow vegetatively, through sending underground rhizomatous roots, which rise above the ground with a tiller of several leaves, spread over a distance from the parent plant (Plate 2) (DAWE 2021da).

The leaves of Matted Flax-lily are generally glaucous, blue in colour but may be red at the base and usually but not always having small hooks (teeth) along the margins and midrib. The leaves taper to approximately 45 centimetres long depending on site and climatic conditions, and are born on tillers with the leaves arranged alternatively, with several leaves per tiller. Matted Flax-lily generally flowers between November and January but may continue flowering with summer and autumn rains. It has pale blue to violet flowers with bright yellow stamens and berries, which are generally purple in colour. The flowers and berries are born on culms extending to typically 30 centimetres in height but this may alter depending on plant location and season (Carter 2010).

Matted Flax-lily typically occurs in grassland and grassy woodland habitats, on well drained to seasonally wet fertile sandy loams to heavy cracking clay soils derived from Silurian or Tertiary sediments, or from volcanic geology (Carter 2010). The species has the potential to persist within areas of Plains Grassland and open woodland habitats recorded within the study area (Figure 4, Figure 5). However, the likelihood of occurrence was considered low within highly degraded areas of grassland not supporting embedded rock, typically identified as PG1 (Figure 2, Figure 3). Areas of higher quality grassland (PG2, NTGVVP) and areas combining native vegetation and embedded rock were considered likely habitat for the species (Figure 4a and Figure 4b).

The high quality (i.e. native and relatively undisturbed) habitat was systematically traversed at approximately five metre linear intervals in accordance with the survey guidelines for Matted Flax-lily outlined in the Biodiversity Precinct Structure Planning Kit (DSE 2010). These survey guidelines are considered 'best practice' guidelines for conducting Matted Flax-lily Surveys.

The species was also a focus of detection during third and forth Golden Sun Moth surveys that were undertaken during the species 2019/20 and 2020/21 flight seasons. In these instances, up to six staff were on-site undertaking Golden Sun Moth surveys on foot. In areas of potential habitat, these surveys were conducted along five metre transects as per the recommended survey guidelines detailed in the Biodiversity Precinct Planning Structure Kit (DSE 2010).



Plate 1. Large-headed Fireweed (Marc Freestone 2020 – Royal Botanic Gardens)



Plate 2. Matted Flax-lily (Ecology and Heritage Partners Pty Ltd).

2.3.2.3 Clover Glycine

Clover Glycine is a decumbent or ascending herb listed as Endangered under the EPBC Act, listed under the Victorian FFG Act, and as endangered under the Advisory List of Rare and Threatened Plants in Victoria (DEPI 2014). The species is widespread across Victoria, New South Wales and Tasmania but with sporadic occurrence. It occurs in grassy EVC such as Plains Grassland (EVC 132), Plains Grassy Woodland (EVC 55), Plains Woodland (EVC 803) and Plains Grassland/Grassy Woodland Mosaic (EVC 897) (DAWE 2021b).

The species is a small perennial herb with leaves that look similar to common pasture clover (Plate 3). A distinguishing feature is the stipules that are egg or kidney shaped and wrap around the stem, and the flowers are purple to pink, pea like, and up to six millimetres long typically flowering between September – December (DAWE 2021b).

Clover Glycine has the potential to occur within areas of higher quality Plains Grassland recorded within the study area (PG2, NTGVVP) (Figure 4; Figure 5). Despite such areas supporting suitable habitat, the impact of historical and active grazing throughout the study area was evident from both native and introduced herbivores and cattle, which was noted during the surveys. As the species is palatable to both native and introduced species (DAWE 2021b) the likelihood of occurrence was considered low. Nevertheless, targeted surveys for the species were undertaken within areas of higher quality native vegetation.

Areas of higher quality grassland (PG2, NTGVVP) and areas combining native vegetation and embedded rock were considered likely habitat for the species (Figure 4a; Figure 4b). These areas were traversed on foot, with surveys conducted along transect lines roughly five metres apart, as per the recommended survey guidelines detailed in the Biodiversity Precinct Planning Structure Kit (DSE 2010).

The species was also a focus of detection during surveys 3 and 4 of the Golden Sun Moth surveys that were undertaken during the species 2019/20 and 2020/21 flight seasons. In these instances, up to six staff were on-site undertaking Golden Sun Moth surveys on foot. In areas of potential habitat, these surveys were conducted along five metre transects as per the recommended survey guidelines detailed in the Biodiversity Precinct Planning Structure Kit (DSE 2010).

No accessible reference sites within the locality were able to be visited prior to the targeted surveys. However, surveys were conducted by qualified ecologists who were familiar with the target species.

2.3.2.4 Button Wrinklewort

Button Wrinklewort is a tufted, simple or few-branched erect herb listed as Endangered under the Commonwealth EPBC Act, listed under the Victorian FFG Act, and as endangered under the Advisory List of Rare and Threatened Plants in Victoria (DEPI 2014). The species occurs in the Southern Tablelands of NSW and ACT, the Gippsland Plains in eastern Victoria, and the Volcanic Plains of western Victoria (DAWE 2021c). The species is a perennial wildflower that grows in grassland and woodland communities within the Victorian Volcanic Plain Bioregion (Plate 4) (DAWE 2021c). It is primarily associated with Kangaroo Grass with an open distribution between tussocks (Morgan 1995).

The dominant grassland species was Wallaby-grass often defined by the minimum 25% native perennial cover, which is not considered likely habitat for the species in combination with a lack of historical records. Nevertheless, targeted surveys for the species was undertaken where Kangaroo Grass was observed, and within areas of higher quality grassland (PG2, NTGVVP) (Figure 4a; Figure 4b).

No accessible reference sites within the locality were able to be visited prior to the targeted surveys. However, surveys were conducted by qualified ecologists who were familiar with the target species. Areas of high quality potential habitat within the study area were traversed on foot, with surveys conducted along transect lines roughly five metres apart, or as dictated by the density of previous agricultural disturbance, existing grasses and weeds as per the recommended survey guidelines detailed in the Biodiversity Precinct Planning Structure Kit (DSE 2010).



Plate 3. Clover Glycine (Marc Freestone 2020 – Royal Botanic Gardens)



Plate 4. Button Wrinklewort (www.environment.nsw.gov.au).

2.3.2.5 Adamson's Blown-grass

Adamson's Blown-grass is a tufted or rarely shortly stoloniferous annual or short-lived perennial listed as Endangered under the Commonwealth EPBC Act, listed under the Victorian FFG Act, and as vulnerable under the Advisory List of Rare and Threatened Plants in Victoria (DEPI 2014). The species occurs in and around saline depressions on the Volcanic Plain where it was recorded from Portarlington to the east almost to the South Australian border (DAWE 2021d).

The species' inflorescences are delicate, open, up to 25 centimetres in length and remain partly enclosed by the upper leaf sheath until late maturity, often drying to a pale golden colour. Panicles detach from the plant when mature and are blown away by wind (Plate 5) (DAWE 2021d).

The species was previously recorded at two locations in 1995 within the WGGA adjacent to Cowies Creek (Figure 6b) within an area that has since been cropped. Given the location of the historical record and the on ground assessments, Cowies Creek and drainage lines in the NGGA were identified as supporting potential habitat for the species.

The locations of previous records were visited prior to undertaking targeted surveys for the species, however no individuals were observed. Surveys were conducted by qualified ecologists who were familiar with the target species. Areas of potential habitat (i.e. Cowies Creek corridor, drainage lines) within the study area were traversed on foot, with surveys conducted along transect lines roughly five metres apart, as per the recommended survey guidelines detailed in the Biodiversity Precinct Planning Structure Kit (DSE 2010).

2.3.2.6 Spiny Rice-flower

Spiny Rice-flower is a perennial sub-shrub listed as Critically Endangered under the EPBC Act, as threatened under the Victorian FFG Act, and as endangered under the Advisory List of Rare and Threatened Plants in Victoria (DEPI 2014). The species is endemic to Victoria, and is found between the south-west and north-central parts of the State. It occurs in grassy EVC such as Plains Grassland (EVC 132), Plains Grassy Woodland (EVC 55), Plains Woodland (EVC 803) and Plains Grassland/Grassy Woodland Mosaic (EVC 897) (DEWHA 2009a). Spiny Rice-flower is typically found in small populations (<500 individuals) (DEWHA 2009a).

The species is slow-growing and reaches up to 30 centimetres in height (Plate 6). Plants are mostly dioecious (male and female flowers on separate plants) but some plants are monoecious (male and female flower on same plant). It bears small yellow flowers between April and August (DEWHA 2009a).

The majority of historical records within the broader locality have been recorded in Lara and Bannockburn (DELWP 2021b). However, there are two historical records located to the east of the NGGA (Figure 10) and combined with the presence of potential habitat as identified during the field assessments, targeted surveys were undertaken within the following areas of private and public (i.e. roadsides) land identified as potential habitat:

- Patches of native vegetation; and,
- Areas of embedded rock not subject to historical ground disturbance (i.e. ploughing).

The flowering season for Spiny Rice-flower generally occurs between April and August, therefore this is the recommended optimal time to conduct targeted survey (DEWHA 2009a).

Targeted surveys were undertaken between 23 July 2020 and 27 August 2020 comprising over 55 person days of survey. Potential habitat was systematically traversed at approximately five-metre linear intervals in accordance with the survey guidelines for Spiny Rice-flower outlined in the Biodiversity Precinct Structure Planning Kit (DSE 2010) and the Significant Impact Guidelines for the species (DEWHA 2009a), with any significant records mapped and the overall condition of vegetation noted.

A reference site known to support a population of the species located within Bacchus Marsh was used to confirm that the species was flowering, as well as to examine the diagnostic features of the species. Spiny Rice-flower observed at the reference site were flowering at this time, and as such these specimens were easily detectable (Plate 6). The reference site is located in relatively close proximity to the NWGGA and given that the specimens at the reference site were flowering, this provides evidence that the current surveys were conducted at a suitable time to maximise the likelihood of detection for the species within the NWGGA.

A summary of the survey effort compared with the survey guidelines is provided below (Table 9).

Table 9. Surveys undertaken during the detailed ecological investigations compared with the survey requirements outlined in the Biodiversity Precinct Structure Planning Kit and the Significant Impact Guidelines for the species.

Survey Guidelines	Comment
Targeted surveys should be done by people familiar with recognising the subspecies.	Yes. Surveys were completed by assessors familiar with the appearance and ecology of the subspecies.
Multiple surveys may be required to identify the species and provide adequate survey effort.	Given that the species was known to be flowering at the time of the assessments, and any specimens easily identifiable, a single survey effort across most of the properties was considered appropriate to accurately record the species.
Surveys should not be conducted for at least six months after fires and for at least three months after the cessation of grazing (DEWHA Survey Guidelines).	Yes. The study area was not subject to any fires within the specified timeframes. However, it was noted that low levels of stock (sheep, cows) were present within some parcels at the time of the surveys.
Survey Spiny Rice-flower between April and August (easily overlooked when not in flower).	Yes. The targeted surveys were conducted within the flowering period for the species (confirmed at a reference

Survey Guidelines	Comment
	site) by ecologists familiar with the species. Given the survey effort within areas of potential habitat, there is reasonable assurance that individuals were not overlooked.
The targeted survey effort should be directed to all potential habitat areas i.e. remnant grassland including degraded grassland.	Yes. All potential habitat (native and non-native grasslands) within accessible parcels was visually surveyed and traversed in linear transects (i.e. targeted survey areas).
Walk through transects at less than 5m grid intervals are required for all potential habitat.	Yes. Transects of five metres apart were utilised throughout the entire targeted survey areas.
Record the number of plants per land parcel.	Yes. Any observed plants were recorded.

2.3.2.7 State Significant Flora

Several State significant species known to occur, or those considered to have a moderate to high likelihood of occurrence (Appendix 2.2), were surveyed for in areas of potential habitat concurrently with the habitat hectare assessments. Of the species previously recorded within the locality, Leafless Bluebush *Maireana aphylla*, is the only state significant species to be recorded within the NWGGA (north eastern boundary of NGGA).

The habitat hectare assessments conducted between November and January 2020, as well as the additional Golden Sun Moth surveys conducted in November and December 2020 captured the flowering period for the majority of State significant flora that have the potential to occur within the NWGGA. Handheld GPS units were used to record the location of any significant species encountered.

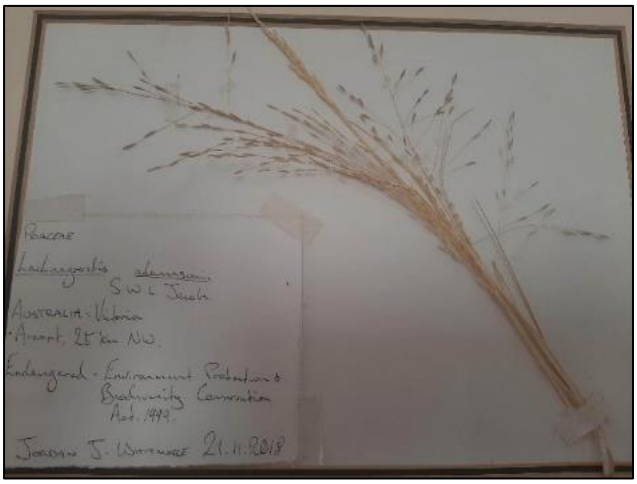


Plate 5. Adamson's Blown-grass (Jordan Whitmore).



Plate 6. Spiny Rice-flower flowering at the Bacchus Marsh reference site (Ecology and Heritage Partners Pty Ltd 2020).

2.3.3 Targeted Fauna Surveys

Based on the findings of the desktop assessment (Section 2.2), and recommendations outlined in the initial ecological assessments (Ecology and Heritage Partners 2017a, 2017b), targeted surveys for significant fauna species were undertaken for the nationally significant Striped Legless Lizard, Growling Grass Frog, Golden Sun

Moth, Australian Grayling and Little Galaxias between November 2019 and December 2020 (Table 10). Surveys were undertaken at a time to maximise the likelihood of detection of significant fauna species identified as having the potential to occur within the NWGGA.

Survey methods along with survey timing and effort is summarised below (Sections 2.3.3.1 - 2.3.3.4).

Table 10. Significant fauna species considered to have the highest likelihood of occurrence within the study area.

Common name	Species Name	Listing under the EPBC Act	Optimal Survey Timing *
Striped Legless Lizard	*Delma impar*	VU	September - May
Growling Grass Frog	*Litoria raniformis*	VU	August - April
Golden Sun Moth	*Synemon plana*	CR	October - January
Australian Grayling	*Prototroctes maraena*	VU	Year round
Little Galaxias	*Galaxiella toourtkoourt*	VU	Year round

Note: * Optimal timing based on recommended survey guidelines; CR = Critically Endangered, VU = Vulnerable.

2.3.3.1 Striped Legless Lizard

Biology

Striped Legless Lizard typically occupy areas of native and introduced grassland, particularly where a high percentage of the native Kangaroo Grass is found. They are typically restricted to lowland tussock grassland habitat (Coulson 1990) in temperate south-eastern Australia, where the species has a limited and patchy distribution. A small percentage of the original habitat for Striped Legless Lizard now exists. As a result, this species is likely to occur in small, isolated populations due to the limited and severely fragmented nature of remaining habitat (Webster *et al.* 2003).

Before European settlement, the Striped Legless Lizard was presumed to be common across many grassland areas in north-eastern, central and south-western Victoria, south-eastern NSW, the ACT, and possibly, south-eastern South Australia (Smith and Robertson 1999). The species has suffered a substantial contraction in both geographic range and abundance over the past 100 years. The range contraction and resultant reduction in population size is likely to continue, due to the ongoing removal, fragmentation and deterioration of suitable grassland habitat (Smith and Robertson 1999). Current populations in Victoria persist primarily in the basalt plains to the west of Melbourne, and areas around Ballarat and Bendigo (Hadden 1995; DSE 2003;).

Since European settlement, the distribution of Striped Legless Lizard has declined, and the species is known to have disappeared from many areas. Within Victoria, an estimated 95% of native lowland grasslands have been substantially altered since European settlement, including Western (Basalt) Plains Grassland community, the primary grassland habitat known to support Striped Legless Lizard. Western Plains Grasslands typically occur on cracking clay soils with at least some surface rock, which provides ideal shelter for Striped Legless Lizard (Coulson 1995).

Striped Legless Lizard inhabits lowland native grasslands, typically dominated by native tussock-forming grass species. In Victorian populations, the species frequents habitats with exposed basalt rocks in grassland and areas of cracking clay soils, where the species can seek refuge under rocks and in earth cracks (Dorrough *et al.* 1995). Although Striped Legless Lizards have been reported from areas of relatively undisturbed native grasslands, with a dense cover of perennial tussock grasses (Kukolic 1991; Kukolic and Osborne 1993), they

are also known to inhabit areas of non-native grassland (Smith and Robertson 1999). This has been shown at several sites throughout the Basalt Plains in western Victoria, which are currently grazed at various stock densities (Rohr and Peterson 2003).

Survey Methods

Targeted Striped Legless Lizard surveys were initially completed through the deployment of four rectangular roof tile grids across the WGGA study area on 1 November 2019, and 23 grids across the NGGA study area on 5, 13 and 14 November 2019. Each tile grid was checked at least eight times between December 2019 and February 2020.

However, based on the limitations and time constraints (Ecology and Heritage Partners was engaged in late October 2019 to undertake the surveys) associated with the targeted surveys undertaken during the 2019/20 survey season within the NWGGA, and further discussions held with DELWP (Garry Peterson – Program Manager Natural Environment Programs – Barwon South West), it was important (given the presence of suitable habitat) that an additional year of targeted Striped Legless Lizard surveys be completed throughout the NWGGA.

The intention of establishing a grid of roof tiles is that Striped Legless Lizard will be drawn to use the artificial habitat for shelter and thermoregulation, and be easily located when the tile is lifted. This method is widely accepted as the primary survey technique for this species, particularly in areas supporting surface rock cover (DSEWPaC 2011a, 2011b). Targeted Striped Legless Lizard surveys were undertaken in accordance with the *EPBC Act Referral Guidelines for the Vulnerable Striped Legless Lizard, Delma impar* (DSEWPaC 2011a) and the Biodiversity Precinct Structure Planning Kit, Guidelines for surveying Striped Legless Lizard *Delma impar* (DSE 2010).,

The survey effort across the 2020/21 survey season comprised 27 grids in the WGGA (23 newly established grids, plus four existing grids from the 2019/20 survey season), and 50 grids in the NGGA (29 newly established grids, plus 21 grids from the 2019/20 survey season) (Appendix 4).

New grids were deployed between 26 August 2020 and 4 September 2020. All tile grids were surveyed on eight separate occasions between 28 September and 30 November 2020 to ensure the highest likelihood of detention (i.e. 95% confidence). The following was undertaken as part of the targeted surveys:

- Tile grids were installed within areas of contiguous habitat as per the densities prescribed in the survey guidelines;
- Tile grids were laid in grids consisting of 50 tiles, at 5 metre spacing between tiles, arranged in grids of 10 tiles by 5 tiles, positioned in vegetated areas with a northerly aspect;
- Two corners of each grid were marked with a wooden or steel stake and clearly marked.
- Grids located in paddocks where cows were present were protected by an electric fence to prevent tiles being destroyed;
- Existing grids (from the 2019/20 surveys) were checked for any damaged tiles and replaced accordingly.
- Tile checks involved systematically lifting each tile in the grid and observing and recording the species utilising the artificial habitat;

- Optimal time for checking is when weather is fine but preferably with >50% cloud cover. Air temperature should be in low – mid 20s and ground temperature high 20s to low 30s (C°); and,
- Grids were not checked more than once a week as this may lead to Striped Legless Lizards abandoning the artificial shelters.

The following was recorded:

- Location and number of each tile grid;
- Date and weather conditions for each survey;
- A table of results including a breakdown of what tile grids were checked on which dates / intervals
- Location and number of any Striped Legless Lizard recorded; and,
- Any non-target species identified (the tile-grid method is likely to identify other reptiles and small marsupials on site, including the DELWP vulnerable listed Tussock Skink *Pseudemoia pagenstecheri* and Near Threatened Fat-tailed Dunnart *Sminthopsis crassicaudata*.

Although the time between the establishment of tile grids and the commencement of tile checks was less than the three month period recommended by the Survey Guidelines for Australia's Threatened Reptiles (DSEWPaC 2011a), the three week period was considered appropriate by DELWP (Garry Peterson), with a greater importance placed on commencing the surveys in late September to maximise the likelihood of detection during the peak period of detectability for the species (late September – late November) (Scroggie *et. al.,* 2019).

2.3.3.2 Growling Grass Frog

Habitats favoured by the Growling Grass Frog (Plate 8) include permanent or largely permanent still water bodies with extensive emergent and submergent vegetation (DEPI 2013; Hero *et al.* 1991; Robertson *et al.,* 2002). The species is also associated with swamps, irrigated areas, farm dams, former quarry holes and off-stream habitats (DSE 2012). Suitable terrestrial habitat for post-breeding dispersal and overwintering refuge sites are also required, these include dense ground-level vegetation, rocks, logs and other ground debris (Robertson *et al.,* 2002). This species can also utilise temporarily inundated waterbodies for breeding purposes provided they contain water over the breeding season (Organ 2003).

Based on previous investigations there is a strong correlation between the presence of the species and key habitat attributes at a given waterbody. For example, the species is typically associated with waterbodies supporting an extensive cover of emergent, submerged and floating vegetation (Robertson *et al*. 2002, Organ 2004, 2005). Emergent vegetation provides basking sites for frogs and protection from predators, while floating vegetation provides suitable calling stages for adult males and breeding and oviposition (egg deposition) sites. Terrestrial vegetation (grasses, sedges), rocks and other ground debris around wetland perimeters also provide foraging, dispersal and over-wintering sites for frogs.

Overwintering sites recorded by Wilson (2003) included crevices beneath basalt boulders, crevices amongst rock - rubble, and dense vegetation at ground level, including emergent macrophytes and grasses. Most were located close to the waterline (within 100 metres). Wassens *et al.* (2008) observed a similar preference for shelter sites close to the water's edge. Most individuals sheltered among dense vegetation, but a few sheltered in soil cracks and the burrows of freshwater crayfish.

Suitable habitat for the Growling Grass Frog was identified in the WGGA only. Although the NGGA did hold farm dams that can provide habitat for the species, on ground observations showed a lack of fringing habitat required for the species, and as such were not surveyed. Habitat within the WGGA was identified throughout Cowies Creek, and the Moorabool River (Figures 4 and 5).

An initial site walkover to identify potential suitable habitat at accessible properties within the WGGA for the Growling Grass Frog was undertaken by a qualified zoologist on the 13 and 14 November 2019.

Analysis of detection probability thresholds specified by DELWP based on the survey protocols to be adhered to for this study, determines specific cumulative probabilities of detection during the breeding season. For a detection probability threshold of 0.95, two nights' surveys are recommended at each site. For a probability threshold of 0.99, three nights' surveys are recommended at each site (Heard *et. al.* 2010).

Nocturnal targeted surveys were completed within the Moorabool River on three separate occasions (13 December 2019, 26 and 28 February 2020); and Cowies Creek on two occasions (6 December 2019 and 12 January 2020). Targeted surveys were undertaken within all accessible areas of potential habitat within the WGGA (Figure 5). The survey was conducted with reference to the prescribed methods detailed in the following guidelines:

- Significant Impact Guidelines for the Vulnerable Growling Grass Frog (Litoria raniformis) EPBC Act Policy Statement 3.14 (DEWHA 2009e);
- Survey Guidelines for Australia's Threatened Frogs (DEWHA 2010); and,
- Biodiversity Precinct Structure Planning Kit (DSE 2010).

Two ecologists experienced in amphibian surveys, including significant species such as Growling Grass Frog, conducted nocturnal surveys during mild (approximately 13-25°C) conditions. Spotlighting and active searching was undertaken during the surveys, both of which are reliable techniques used to detect the species. The margins (within ~30 metres) of the waterbodies were carefully searched for active frogs using 30 watt 12 volt hand-held spotlights. Suitable refuge sites such as logs, rocks and other ground debris were lifted opportunistically to locate inactive frogs. At least three hours was spent actively searching for frogs during each survey.

Specifically, targeted surveys including call playback, and active searching focussed on the entirety of Cowies Creek within the study area, and the stretch of the Moorabool River, which borders the Western Growth area (Figure 6b). Other water bodies such as farm dams within the WGGA were dry, devoid of any fringing vegetation and considered isolated from Cowies Creek and the Moorabool River. As such, these areas were considered poor quality habitat for listed species, and were not specifically surveyed as part of the targeted survey effort.

Detailed habitat assessments were undertaken concurrently with the targeted surveys to further assess the suitability of habitats within the WGGA. The following attributes of habitat quality for the Growling Grass Frog were recorded:

- The hydroperiod;
- The location and extent of instream pools and off-stream waterbodies;
- Habitat values of each waterbody including the type (pond, dam, wetland, creek, billabong, drain or ditch) flow (still, slow rapid), depth and presence of terrestrial refuge sites (e.g. rocks, logs, debris);

- Aquatic vegetation cover (% cover of emergent, submergent and floating aquatic plants); and,
- Barriers to frog movement between waterbodies.

The hydroperiod (as defined in Heard *et al.,* 2010) is the likelihood that an individual wetland will remain inundated over the course of a single breeding season, on an ordinal scale where:

- 0 = fills only in years with above average rainfall (intermittent);
- 1 = fills and dries out annually with average rainfall (ephemeral);
- 2 = dries out only during years of below average rainfall (semi-permanent);
- 3 = never dries out regardless of rainfall (permanent).

Habitat quality was defined with reference to the following criteria:

- High quality habitat: Areas that currently contain or have a high likelihood to contain important habitat attributes required by the species for breeding as well as foraging and dispersal (e.g. permanent or semi-permanent, extensive aquatic vegetation, high water quality, connected to other occupied sites, absence or low densities of predatory fish, high cover of terrestrial refuge sites).
- Moderate quality habitat: Habitat that supports one or more key habitat characteristics outlined above, but not all (for example site may be important for dispersal or foraging but not breeding).
- Low quality habitat: Sites unlikely to be used by Growling Grass Frogs for breeding and a low likelihood for dispersal due to one or more of the following; absence or lack of aquatic vegetation, low water quality, presence of predatory fish, lack or low cover of terrestrial refuge sites.
- No suitable habitat / degraded: Areas consisting of open pasture have generally been cleared from previous land use activities and are highly modified areas dominated by exotic vegetation (i.e. open pasture) in poor condition and located some distance (e.g. over 200 metres) from wetland habitat .

The initial survey detected the species within Cowies Creek (Figure 6). This area was then used as a reference site during subsequent surveys to confirm that the species was active/calling immediately prior to undertaking the survey. The species was both observed and heard to be calling at this location on multiple occasions and it is considered suitable for use as a reference site.

2.3.3.3 Golden Sun Moth

Golden Sun Moth (Plate 7) typically occur 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 1999). The male of this species generally flies between 11am and 3pm on calm, warm (over 20°C), sunny days (Plate 7).

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.

The NWGGA supports broad areas of suitable habitat for the species (Figure 4a; Figure 4b), particularly in the NGGA, which consists of both native habitat comprised of Wallaby-grass, and non-native habitat dominated by the noxious weed Chilean Needle-grass *Nassella neesiana* .

Targeted surveys for Golden Sun Moth were undertaken during the 2019/20 flight season, with further surveys undertaken during the 2020/21 flight season, in all accessible areas of potential habitat that were not able to be adequately surveyed prior (Figure 4a; Figure 4b) (Table 4).

Survey procedures were in accordance with the *Significant Impact Guidelines for the Critically Endangered Golden Sun Moth* (DEWHA 2009b) and Biodiversity Precinct Structure Planning Kit (DSE 2010), with the following tasks undertaken:

- Surveys were conducted by ecologists experienced in the detection and identification of Golden Sun Moth;
- Each parcel containing suitable habitat was surveyed on four separate occasions, with at least one week between surveys where possible, and at least two days since rain (unless confirmed flying at a reference site within two days of rain);
- Surveys 1 and 2 were conducted using parallel transects at 50 metres and 25 metres apart respectively with observers walking or, if terrain permits, driving in a car at < 10 km / hour (flying male moths can be readily seen from a vehicle) until moths are observed. Tracks (transects) will be recorded with a GPS to show where survey has been undertaken;
- In accordance with the *Biodiversity Planning Kit* (DSE 2010), Surveys 3 and 4 were undertaken along transects at 10 metres apart;
- Surveys were only undertaken on days when the species had been observed flying at a local reference site (i.e. either on-site, or within a site in Bacchus Marsh);
- Surveys took place during the species' known flight season (with both the 2019/2020 and 2020/2021 flight seasons occurring between early November and mid-January). Moths were confirmed flying at known, nearby reference sites (Bacchus Marsh, Lovely Banks) prior to undertaking each survey;
- Surveys were undertaken during weather conditions suitable for detecting the species. Male moths generally fly between 10am and 3pm on warm (over 20˚C by 10am) days with minimal cloud cover and still conditions. However, if males are observed flying on site after 3pm or during moderately windy conditions surveys can continue until males are no longer observed flying; and,
- Surveys were conducted using parallel transects with observers walking or, if terrain permitted, driving in a car at < 10 kilometres / hour (flying male moths can be readily seen from a vehicle) until moths are observed).



Plate 7. Golden Sun Moth (Ecology and Heritage Partners Pty Ltd).



Plate 8. Growling Grass Frog (Ecology and Heritage Partners Pty Ltd).

2.3.3.4 Australian Grayling and Little Galaxias

Australian Grayling Biology

Australian Grayling *Prototroctes maraena* is a small to medium-sized, slender, silvery fish with soft-rayed fins lacking any spines growing commonly to between 17-19 centimetres, but up to 33 centimetres. A sexually dimorphic fish, the majority of its life is spent in freshwater, however, at least some of its larval and juvenile stage is spent in coastal seas (Backhouse *et al*. 2008).

The species is most commonly associated with cool, clear, freshwater streams with gravel substrate and areas alternating between pools and riffle zones. In the Tarwin River system, they have also been associated with muddy-bottomed, heavily silted habitat (Backhouse *et al*. 2008).

Spawning occurs in freshwater environments in late summer through to early winter and is generally triggered by an increase in the volume and flow rate of streams, possibly combined with a decrease in water temperature (Backhouse *et al*. 2008). The exact timing is dependent on location and annual conditions. Upon hatching larvae are swept downstream into estuarine areas where they disperse in the marine environment until approximately six months of age. Juveniles then migrate back into freshwater, where they are believed to remain for the remainder of their lifecycle (Backhouse *et a*l. 2008). It is believed that most adults die after their second year, usually after only having spawned for a single season, with a small percentage of the population living for four to five years (Backhouse *et a*l. 2008).

Key threats to Australian Grayling include (DAWE 2021e; Backhouse *et al*. 2008).

- Habitat destruction and degradation;
- Barriers to fish movement/migration;
- River regulation;
- Poor water quality;
- Siltation;
- Introduced fish;

- Climate change;
- Disease; and,
- Recreational fishing

Little Galaxias Biology

Little Galaxias typically occurs in slow flowing and still waters and usually in shallow water with abundant aquatic vegetation. This includes permanent and temporary waterbodies, swamps, billabongs, drains and backwaters of creeks (McDowall 1996). This species is often (but not always) found amongst dense macrophytes that provide sufficient cover including the floating *Triglochin* spp., and submerged *Potamogeton* spp., (Saddlier *et al*. 2008; Ecology and Heritage Partners, unpublished data). Little Galaxias may become dormant when pools dry, potentially burying within the substrate or using burrowing crayfish burrows as shelter (Saddlier *et al*. 2008).

Survey Methods

Targeted surveys were undertaken by qualified aquatic ecologists experienced in the survey methodology and identification of Australian Grayling and Little Galaxias. A constructed weir spans the Moorabool River within the western stretch of the WGGA and would form a physical barrier to upstream movement of the species. Accordingly, targeted surveys were undertaken both upstream and downstream of the weir to increase the likelihood of detecting the species.

Targeted surveys focussed on areas of likely habitat were undertaken in accordance with *Survey guidelines for Australia's threatened fish* (DSEWPaC 2011d) and included:

- Boat based electrofishing. Boat-based electrofishing is generally considered to be most efficient in areas of low turbidity (where fishes can be seen easily) and mid-range conductivity (100–500 ų S cm-1) (Cowx and Lamarque 1990, in Faragher and Rodgers 1997). During the 'NSW Rivers Survey', boat-based electrofishing methods captured the greatest number of fishes and 50 of the 55 species sampled (Faragher and Rodgers 1997). Four of the five species it did not sample were rarely caught in the survey and were mainly estuarine (Faragher and Rodgers 1997). Boat based electrofishing methods are useful for sampling fishes in areas that are navigable by boats and more than half a metre deep. The efficiency of boat-based electrofishing techniques decreases with increasing water depth, and at depths of greater than 3–4 metres benthic species may not be affected, or capture/recovery efficiency decreases (Raadik, T.A. pers. comm.);
- Backpack electrofishing. Backpack electrofishing, to a maximum depth of operator hip height, is a useful collection method in shallow freshwater pools and riffles that are unsuitable for boating (Faragher and Rodgers 1997). Backpack electrofishing may be appropriate in shallow upland streams, although is generally not as successful in lowland rivers where water depth is greater than 1 metre. Backpack electrofishing is also limited to water bodies with low to moderate salinity (Hannon 2008); and,
- Fyke netting (with excluders attached). Fyke nets can be set overnight and the contents examined and counted the following morning. Issues that can arise with fyke nets are drowning (for example if platypus or turtles are captured) and predation of smaller fish if large fish (such as eels) are captured

(Raadik, T.A. Mar 2004, pers. comm.). Fyke nets should be set to allow animals such as platypus and turtles to breathe at the surface of the water if they become trapped (Pidgeon 2004).

Moorabool River

Four ten minute periods of boat electrofishing (Grassl high frequency electrofisher set to 50 pulses per second and 200 volts; (Plate 9; Plate 10) were undertaken above the weir. A total of four fyke nets (with excluders installed) were set in areas of likely habitat and left overnight (Plate 11: Plate 12).

Approximately 40 minutes of backpack electrofishing were undertaken below the weir using a Smith-Root, Inc. LR-24 Electrofisher. A total of two fyke nets were set in areas of likely habitat (including excluders and left overnight. Water quality was collected using a Professional Plus water quality meter (Plate 13) and a Hach 2100Q turbidity meter (Plate 14).



Plate 9. Grassl high frequency electrofisher set to 50 pulses per second and 200 volts (Ecology and Heritage Partners Pty Ltd 12/12/2019).



Plate 10. Smith-Root, Inc. LR-24 Electrofisher (Ecology and Heritage Partners Pty Ltd 12/12/2019).

Cowies Creek

Due to high salinity levels (>1500 microsiemen per centimetre excludes backpack electrofishing) and the shallow nature of the waterbodies within Cowies Creek electrofishing was not a feasible option. A total of eight (8) fyke nets (including excluders) were set within Cowies Creek overnight and checked the following morning.



Plate 11. Fyke net fitted with excluders to block Platypus and Rakali from entering the net (Ecology and Heritage Partners Pty Ltd 12/12/2019).



Plate 12. Fyke net set below the weir in areas of high quality habitat (Ecology and Heritage Partners Pty Ltd 12/12/2019).



Plate 13. Professional Plus water quality meter (Ecology and Heritage Partners Pty Ltd 12/12/2019).



Plate 14. Hach 2100Q turbidity meter (Ecology and Heritage Partners Pty Ltd 12/12/2019).

2.4 Likelihood of Occurrence Assessment

Relevant biological databases, literature and expert advice were used to identify all species records of national, State and regional conservation significance within 10 kilometres of the NWGGA. The proximity, number, dispersion and date of known locality records (assuming over-dispersed and random patterns of locality records being more likely to occur in the NWGGA) were considered to determine a species' likelihood of occurrence within the NWGGA.

Additional factors also taken into consideration include: the known biogeographical distribution of the species; underlying geology of existing locality records; and vegetation and habitat associations. The decision guidelines for determining the likelihood of occurrence of flora and fauna species are presented in Table 11 and Table 12 respectively.

The results of the likelihood of occurrence assessment for listed flora and fauna species are provided in Appendices 2.2 and 2.3, respectively.

All significant flora and fauna species considered to have the highest likelihood of occurrence within potential habitats within the NWGGA are discussed in the body of this report.

Table 11. Decision guidelines for determining a flora species likelihood of occurrence within the NWGGA.

Likelihood of occurrence	Ecology and Heritage Partners Decision Criteria
1 – Known occurrence	Recorded within the NWGGA recently (i.e. within ten years).
2 - High	Previous records of the species in the local vicinity; and/or, the NWGGA contains areas of high-quality habitat.
3 – Moderate	Limited previous records of the species in the local vicinity; and/or, the NWGGA contains some characteristics of the species' preferred habitat.
4 – Low	Poor or limited habitat for the species however other evidence (such as a lack of records or environmental factors) indicates there is a low likelihood of presence.
5 – Unlikely	No suitable habitat and/or outside the species range.

Table 12. Decision guidelines for determining fauna species likelihood of occurrence within the NWGGA.

Likely presence or use of the study area	Ecology and Heritage Partners Decision Criteria
1 – Known occurrence	Recorded within the NWGGA recently (i.e. within ten years).
2 - High	Likely resident in the NWGGA based on database records, or expert advice; and/or, recent records (i.e. within ten years) of the species in the local area; and/or, the NWGGA contains the species' preferred habitat.
3 - Moderate	The species is likely to visit the NWGGA regularly (i.e. at least seasonally); and/or, previous records of the species in the local area; and/or, the NWGGA contains some characteristics of the species' preferred habitat.
4 - Low	The species may visit the NWGGA occasionally or opportunistically whilst en route to more suitable sites; and/or, there are only limited or historical records of the species in the local area (i.e. more than 20 years old); and/or, the NWGGA contains few or no characteristics of the species' preferred habitat.
5 - Unlikely	No previous records of the species in the local area; and/or, the species may fly over the NWGGA when moving between areas of more suitable habitat; and/or, out of the species' range; and/or, no suitable habitat present.

2.5 Assessment Qualification and Limitations

Data and information held within the ecological databases and mapping programs reviewed as part of the desktop assessment (e.g. VBA, PMST, NatureKit Maps etc.) are unlikely to represent all flora and fauna observations within and surrounding the NWGGA. It is therefore important to acknowledge that a lack of documented records does not necessarily indicate that a species or community is absent. Furthermore, a documented record may indicate a species' presence in an area at a given point in time, but it generally does not offer information about how a species is making use of an area (e.g. foraging, nesting, dispersing). This can be important information when determining the potential impact of a proposed action on a threatened species.

The 'snap shot' nature of a biodiversity assessment, meant that migratory, transitory or uncommon fauna species may have been absent from typically occupied habitats at the time of the field assessment. In addition, annual or cryptic flora species such as those that persist via underground tubers may also be absent. Nevertheless, the terrestrial flora and fauna data collected during the field assessment and information

obtained from relevant desktop sources is considered adequate to provide an accurate assessment of the ecological values present within the NWGGA.

Ecological values identified within the NWGGA were recorded using a hand-held GPS or tablet with an accuracy of +/-3 metres. This level of accuracy is considered adequate to provide an accurate assessment of the ecological values present within the NWGGA; however, this data should not be used for detailed surveying purposes.

2.5.1 Access Constraints

The ecological site assessment was restricted to parcels/properties where access was permitted (Figure 2; Figure 3). This resulted in a total of 754.82 hectares out of a total of 2,245 hectares (approximately 33.6%) of the NGGA, and 100.85 hectares out of a total of 770 hectares (approximately 13.1%) of the WGGA not being subject to on-ground assessments.

Where access to parcels/properties was not permitted, a visual assessment was conducted from areas of public access such as reserves, roadsides and adjacent properties where possible. Patches of native vegetation were identified from a distance, however the extent and quality throughout was estimated based on extent of vision and species observed nearby. As this is not an acceptable method of determining the extent and quality of native vegetation, nor the presence of suitable habitat for rare or threatened species, where access was not permitted, the extant (2005) DELWP modelled extent of native vegetation (DELWP 2021b) has been used to give an indication of the potential values present within unassessed land. Even where parcels were confirmed to support native vegetation, given they could not be accurately mapped, the extent of native vegetation or habitat for rare or threatened species in parcels where access was not granted is not included in the totals detailed in this report. Further on-ground assessments will be required to confirm the quality and extent of native vegetation within these parcels, as well as the presence of habitats for significant flora or fauna.

2.5.1.1 Qualifications relating to ecological values within parcels not assessed

For the purposes of this report, the 'study area' refers to areas within the NWGGA that were subject to the on-ground assessments. As such, the results of the field assessments, including data related to the presence or absence of significant flora, fauna and ecological communities and associated implications detailed in this report relate only to the areas that were subject to the on-ground assessments (unless specifically indicated otherwise).

It is acknowledged that several unassessed properties within the NWGGA are likely to support ecological values that have not been observed or recorded as part of this suite of ecological investigations. Based on the quality and extent of known habitats within the NWGGA, particularly, the NGGA, it is highly likely that the extent of suitable habitat as shown on Figure 6a extends beyond areas adequately surveyed during the 2019/20 and 2020/21 survey seasons. In addition, based on visual assessments from roadsides indicating the presence of native vegetation (Figure 2), as well as the presence of modelled extant (2005) native vegetation and Landcover data (DELWP 2021b; Table 15), it is highly likely that additional patches of native vegetation are present within these areas (Figure 2; Figure 3).

High level implications and recommendations associated with unassessed parcels within the NWGGA are provided in Section 7.1.

2.5.2 Spiny Rice-flower

It was noted at the time of the Spiny Rice-flower surveys that low levels of stock (sheep, cows) were present within some parcels. However, biomass levels were generally moderate, and it is considered unlikely that the existing levels of grazing adversely impacted the results of the targeted surveys.

2.5.3 Striped Legless Lizard Surveys

Although the time between the establishment of 2020 season tile grids and the commencement of tile checks was less than the three month period recommended by the Survey Guidelines for Australia's Threatened Reptiles (DSEWPaC 2011a), the three week period was considered by DELWP (Garry Peterson pers. comm.) to be appropriate in this instance, with a greater importance placed on commencing the surveys in late September to maximise the likelihood of detection during the peak period of detectability for the species (late September – late November) (Scroggie *et. al.,* 2019).

In this instance, to compensate for the shorter period prior to the first tile check, all tile grids were checked on eight occasions, over a 10 week period, which exceeds the number of checks recommended (i.e. six checked recommended) in the guidelines (DSEWPaC 2011a).

Based on the results of previous Striped Legless Lizard surveys undertaken west of Melbourne, it has regularly been observed that Striped Legless Lizard (and other reptiles) will generally commence using artificial shelter sites (i.e. tiles) 2-3 weeks after the tiles are established. Several reptile species, including the Eastern Blue-tongued Lizard *Tiliqua scincoides scincoides* were detected under tiles during the first tile check on 30 September 2020. Further, nearby sites that were subject to similar constraints regarding the timing of tile deployment recorded several instances of Tussock Skink and Marbled Gecko *Christinus marmoratus* after the first tile check. This provides substantive evidence that reptiles can regularly and opportunistically acclimatise to using artificial shelter tiles for thermoregulation and cover within short timeframes.

The peak detection of Striped Legless Lizard typically occurs between late September – late November (DSEWPaC 2011a; Scroggie *et. al.,* 2019). As such, it is considered that the survey timing was appropriate (high detection probability) to detect the species should a resident population of the species occur within the NWGGA.

2.5.4 Golden Sun Moth

Recommended survey guidelines specify targeted searches for the species be conducted within climatic conditions relating to temperature (above 20 degrees Celsius before 10am) with minimal cloud cover, wind speed and days since rain. Surveys for the species were conducted in line with the recommended conditions, although if the species was confirmed flying at a reference site during conditions outside of the optimal conditions stated in the recommended survey guidelines, then surveys proceeded under sub-optimal conditions until the species was no longer recorded.

The suboptimal conditions of high winds, rain, and cool weather over the 2019/20 and 2020/21 flight season meant that it was not always possible to achieve at least a one week period between surveys at a given parcel. Given the suboptimal survey conditions and extensive area of known and potentially suitable habitat across the WGGA and NGGA, targeted surveys had to be undertaken opportunistically when conditions were optimal, and/or the species was confirmed to be flying. As such, the surveys may not have captured the additional emergence of larvae, making it difficult to capture the size of the full population of the species. However, it is

noted that where the species was recorded in areas of suitable habitat, the entire contiguous extent of suitable habitat has been noted as confirmed habitat for the species. Further, high numbers of the species were recorded in several parcels, and additional numbers of the species would not alter the findings or implications of the assessments.

Due to the volume of surveys that were undertaken, the GPS/Trimble units used during surveys to record tracks ran out of memory on occasion, and in those instances, either wrote over existing track data stored on the unit, or stopped recording completely. Further, some surveys were conducted by up to six staff, with only one or two staff recording tracks in these instances. Therefore, the tracks shown in Figure 9a and Figure 9b do not always show transects located at exactly 50 metres, 25 metres or 10 metres apart. However, all sites were surveyed at least four times in accordance with the recommended survey procedures detailed in the *Significant Impact Guidelines for the Critically Endangered Golden Sun Moth* (DEWHA 2009b) and Biodiversity Precinct Structure Planning Kit (DSE 2010).

2.5.5 General Limitations

General ecological limitations associated with the ecological investigations include:

- Surveys for listed flora and fauna species were undertaken during the optimal flowering/breeding period for all targeted species to maximise the probability of detecting each species. Given that accessible areas of suitable habitat for significant flora and fauna species were extensively surveyed, it is considered that sufficient effort has been employed to determine the likely presence or otherwise of targeted species within accessible areas. However, areas that could not be accessed to adequately conduct surveys have been identified as requiring additional surveys;
- The assessment of likelihood of occurrence is based on survey effort and results, background information and previous records compiled;
- During the habitat hectare assessments, it was noted that several parcels contained low stock levels (sheep, cows). However, in some instances, paddocks were heavily grazed which made the identification of flora (grasses in particular) difficult during the habitat hectare assessments. Over subsequent assessments undertaken throughout 2020 (i.e. targeted surveys for Spiny Rice-flower, Striped Legless Lizard and Golden Sun Moth), accredited vegetation assessors were able to revisit areas supporting native vegetation to confirm the quality and extent of mapped patches. As such, the quality and extent of native vegetation was checked multiple times throughout 2020 which provided a high level of confidence that the initial habitat hectare mapping was not adversely impacted by grazing intensity.
- The parcel located at 85-105 Ballan Road was visited in late August 2020 and at this time was revealed that the paddock had been cleared and cropped. This site was previously mapped as containing 18.455 hectares of Plains Grassland EVC. Given that the parcel has been cropped, this version of the report no longer classifies the parcel as supporting potential habitat for significant flora or fauna. In addition, the Plains Grassland EVC is no longer shown within the parcel (Figure 3), and the extent of native vegetation no longer contributes to the overall extent of native vegetation within the WGGA.
- Non-vascular flora (i.e. mosses, liverworts) were not recorded, although their presence is noted as part of the cover of native species in the definition of a patch of native vegetation;

- Ecological features identified during field assessments were recorded using a hand-held GPS or tablet with an accuracy of between +/- 3 to 5 metres. This level of accuracy is considered adequate to provide an accurate assessment of the ecological features present within the NWGGA; however, this data should not be used for detailed surveying purposes; and,
- For cryptic and less abundant species that are known to, or that have the potential to use habitat resources within the NWGGA as a resident or a visitor on a regular or infrequent basis, the precautionary principle (i.e. the absence of a species during targeted surveys is not used as a reason for assuming the species is not present, or may utilise habitats within the NWGGA, particularly where the species was/is known to occur within the locality, and the NWGGA supports suitable habitats) has been applied when determining the likelihood of occurrence.

3 EXISTING ENVIRONMENT

The following description of the existing environment is based on the landscape, vegetation, fauna habitats and species identified from the desktop assessment and within the study area during the ecological surveys.

3.1 Ecological Values

It should be noted that access was not permitted in several parcels within the NWGGA, with approximately 33.6% and 13.1% of the overall land within the NGGA and WGGA respectively unable to be assessed on-ground (Figure 2; Figure 3).

Ecological values of the NWGGA, as determined through field assessments and targeted surveys undertaken within the accessible property parcels, are summarised below.

3.1.1 Overview

Most of the NWGGA is highly modified due to past and current agricultural and farming practices and is dominated by pasture supporting non-indigenous grasses and weeds. Much of the indigenous vegetation and terrestrial fauna habitat remaining within the NWGGA is confined to riparian corridors (i.e. Moorabool River, Cowies Creek), or agricultural areas not subjected to historical cropping activities.

The on-ground mapping is broadly consistent with the DELWP modelled Landcover data (DELWP 2021b), which shows approximately 63% of the NGGA (Figure 2f) and 72% of the WGGA (Figure 3g) to be comprised of exotic pasture/cropping land (Table 13).

However, the extent of native vegetation is overestimated, but is broadly in the correct location (Figure 2, Figure 2f). Where native pasture/grassland is modelled to occur, on-ground assessments generally revealed native vegetation to be present, but below the 25% cover threshold required to be classified as a patch of native vegetation in accordance with the Guidelines (DELWP 2017b). A summary of modelled land-use extent is provided in Table 13, and shown in Figure 2f and Figure 3g.

Table 13. DELWP modelled Landcover extent (2015-1029).

Landcover Class	Status	NGGA	WGGA
		Area (ha)	Area (ha)
Native pasture / grassland	Native	466.75	43.21
Native scrubland	Native	1.88	0.75
Treed native vegetation	Native	13.76	13.88
Scattered native trees	Native	85.23	26.26
Natural low cover	Native	8.38	0.75
Wetland - seasonal	Native	16.45	7.57
Wetland - perennial	Native	0.25	0.31
Built environment	Non-native	0.63	0.69
Urban area	Non-native	109.68	54.15

Landcover Class	Status	NGGA	WGGA
		Area (ha)	Area (ha)
Disturbed ground	Non-native	4.38	0.25
Exotic pasture / grassland	Non-native	833.81	331.05
Dryland cropping	Non-native	502.95	222.74
Other exotic tree cover	Non-native	28.2	42.4
Hardwood plantation	Non-native	3	0.13
Horticulture / irrigated pastures and crops	Non-native	47.46	26.39
Conifer plantation	Non-native	0.06	0.06
Water		0.06	-
Total		**2122.93**	**770.59**

Native vegetation, where present within existing farmland, is modified, with vegetation generally lacking structure and/or exhibiting a low diversity of native species.

Despite the modified condition of native vegetation and habitat, the NGGA supports large areas of confirmed habitat for the nationally significant Golden Sun Moth and Striped Legless Lizard, while the riparian corridor along Cowies Creek in the WGGA supports a confirmed population of the nationally significant Growling Grass Frog.

Three EVCs were mapped across the NWGGA: *Low Rainfall* Plains Grassland (EVC_132_63) (WGGA and NGGA), Creekline Grassy Woodland (EVC 68) (WGGA), and Floodplain Riparian Woodland (EVC 56) (WGGA). This is broadly consistent with extant (2005) DELWP modelled mapping that shows both study areas are modelled to contain discrete areas of Plains Grassland (EVC 132), with areas adjacent to the Moorabool River modelled as Floodplain Riparian Woodland (EVC 56) (DELWP 2021c). Higher quality patches of Plains Grassland within the NGGA also met the condition thresholds that define the nationally significant NTGVVP ecological community, while several patches have been classified as the State significant Western (Basalt) Plains Grassland vegetation community (DELWP 2021d) (Figure 2).

Two 'Current Wetlands' are also modelled to occur within the NGGA and Current Wetlands are classified as native vegetation in accordance with Victoria's native vegetation policy 'The Guidelines' (DELWP 2017b) (Section 2.3.1.1). As such, the extent of Current Wetlands within the assessed areas of the NGGA has been included within the overall extent of native vegetation.

Commonly observed species recorded in grassland habitats included Short Wallaby-grass *Rytidosperma carphoides,* Striped Wallaby-grass *Rytidosperma racemosum* var. *racemosum* and Veined Spear-grass *Austrostipa rudis* subsp. *rudis*. River Red-gum *Eucalyptus camaldulensis* was the dominant tree species within the WGGA, however several non-indigenous planted eucalypt species also occur throughout the NWGGA, particularly around dwellings and/or farm sheds/maintenance areas.

Specific details relating to observed EVCs are provided below, with a summary of the extent of each vegetation type provided in Table 14. In areas unable to be accessed, several discrete areas of native vegetation are modelled to occur. A summary of modelled native vegetation values present within unassessed areas within the NGGA and WGGA is summarised in Table 15.

Table 14. Extent of vegetation type (EVC) recorded within the assessed on-ground parcels of the NWGGA.

Ecological Vegetation Class	Bioregional Conservation Significance	Area (hectares) NGGA ^	Area (hectares) WGGA ^
Plains Grassland (EVC 132)	Endangered	153.647	41.413
Floodplain Riparian Woodland (EVC 56)	Endangered	-	23.107
Creekline Grassy Woodland (EVC 68)	Endangered	-	4.859
Current Wetland (modelled)	N/A	2.259*	-
Total		**155.905***	**69.379**

Note. * Current Wetland and a small area of Plains Grassland overlap (Figure 2); ^Only includes native vegetation mapped in the accessible areas.

Table 15. Extent of modelled vegetation type (EVC) modelled to occur within the unassessed areas of the NWGGA (DELWP 2021b).

Modelled Ecological Vegetation Class	Bioregional Conservation Significance	Area (hectares) NGGA	Area (hectares) WGGA
Plains Grassland (EVC 132)	Endangered	111.96	29.40
Floodplain Riparian Woodland (EVC 56)	Endangered	-	2.25
Creekline Grassy Woodland (EVC 68)	Endangered	-	-
Current Wetland (modelled)	N/A	8.12	-
Total		**120.08**	**31.65**

Higher quality fauna habitat within the study areas comprises riparian vegetation along creeklines, including native sedges (*Juncus* spp.) and rushes (*Typha* spp.). At the time of assessment Cowies Creek was not flowing and contained small pools, while the Moorabool River was flowing.

There is suitable habitat for water-dependent species, including the nationally listed Growling Grass Frog, which was observed during diurnal surveys within WGGA. In addition, modified Plains Grassland within farmland provides suitable habitat for Golden Sun Moth, which was detected on multiple occasions within the northern properties of NGGA, although was not observed within the WGGA despite targeted surveys being undertaken.

Several large trees are present along the Moorabool River and contain suitable nesting (hollows and fissures), foraging and roosting habitat for a range of native fauna species, including arboreal mammals (microbats, possums) and birds (owls, parrots and woodland species).

3.1.1.1 Flora

Eighty-four flora species (36 indigenous and 48 non-indigenous or introduced) were recorded within the study area on accessible parcels during the field assessment. No nationally listed flora species were identified during the targeted surveys across the WGGA and NGGA. However, a single state significant flora species, Leafless Bluebush, was recorded at the north eastern boundary of the NGGA (Figure 6a). A consolidated list of flora species recorded is provided in Appendix 2.1.

Noxious Weeds

Nine species recorded in the NWGGA are declared noxious weeds listed under the Victorian *Catchment and Land Protection Act 1994* (CaLP Act) (Table 16). Chilean Needle-grass *Nassella neesiana*, Serrated Tussock *Nassella trichotoma* and African Box-thorn *Lycium ferocissimum* are also Weeds of National Significance (WoNS), under national management as part of the National Weeds.

Table 16. Noxious weeds recorded within the NWGGA.

Species Name	Common Name	CaLP Act Category[1]	WoNS[2]
Nassella neesiana	Chilean Needle-grass	**Restricted Weed**	Yes
Juncus acutus	Spiny Rush		No
Lycium ferocissimum	African Box-thorn	**Regionally Controlled**	Yes
Cirsium vulgare	Spear Thistle		No
Cynara cardunculus	Artichoke Thistle		No
Echium plantagineum	Patterson's Curse		No
Nassella trichotoma	Serrated Tussock		Yes
Rosa rubignosa	Sweet Briar		No
Xanthium spinosum	Bathurst Burr		No

Note: 1) Regionally Controlled Weed and Restricted Weed under the CaLP Act; 2) WoNS under national management.

3.1.1.2 Fauna

Ecological surveys of the NWGGA recorded 75 species of fauna, comprising 62 native species and 13 introduced species (Table 17). Several mammal species were detected (eight species), while a range of bird species were also observed (e.g. woodland specialists and waterbirds), along with those adapted to open and/or modified landscapes (Appendix 3.1). Eleven fish species were recorded during the targeted Australian Grayling surveys along the Moorabool River (WGGA) (Table 17). A consolidated list of fauna species recorded is provided in Appendix 3.1.

Table 17. Summary of fauna species identified within the NWGGA.

Fauna Guild	Species Richness	
	Native	Introduced
Mammals	4	5
Birds	37	5
Reptiles	6	0
Frogs	5	0
Fish	8	3
Invertebrate	2	0
Total	**62**	**13**

Pest Animals

Three of the introduced fauna species recorded within the NWGGA are declared pests under the Victorian CaLP Act (Table 18). These species are classified as Established Pest Animals, which indicates they pose a serious threat to primary production, Crown Land, the environment or community health in Victoria. It is not possible to eradicate these pest animals form Victoria, therefore asset protection is considered to the most effective approach to minimise impacts to high value assets.

Table 18. Pest Animals recorded in the NWGGA

Common Name	Scientific Name	CaLP Act Category[1]	Priority Pest[2]
European Rabbit	*Oryctolagus cuniculus*	**Established**	Yes
European Hare	*Lepus europaeus*		Yes
Red Fox	*Vulpes vulpes*		No

Note: 1) Declared Established pest animal under the CaLP Act; 2) designated for priority control under the CaLP Act.

3.1.2 Native Vegetation

Modelling undertaken by DELWP provides an indication of the likely extent and type of patches of native vegetation present within the NWGGA prior to European settlement (1750), and in 2005 (DELWP 2021b). The 2005 modelling indicates that approximately 20% of WGGA and 30% of the NGGA may support native vegetation, with fragmented patches of Plains Grassland predicted to occur throughout both areas, and Floodplain Riparian woodland to occur along the Moorabool River (DELWP 2021b). Modelled Landcover data confirms the NWGGA is highly modified through agricultural activities (Table 13, Figure 2f; Figure 3g), although overestimates the extent of native vegetation present in the NGGA (Table 13).

Vegetation mapping completed as part of this assessment largely confirms the modelled extent of native vegetation within the NWGGA, with a single EVC recorded within NGGA - Plains Grassland (EVC 132), and three EVC's within WGGA - Plains Grassland (EVC 132), Creekline Grassy Woodland (EVC 68), and Floodplain Riparian Woodland (EVC 56) (Figure 2; Figure 3).

The remainder of the assessed areas within the NWGGA comprises introduced and planted vegetation, present as pasture. Specific details relating to observed EVC is provided below.

3.1.2.1 Low Rainfall Plains Grassland (WGGA, NGGA)

Low rainfall Plains Grassland is typically in the form of treeless vegetation mostly less than one metre tall dominated by largely graminoid and herb life forms. The EVC occupies fertile cracking basalt soils prone to seasonal waterlogging (DELWP 2021c).

Plains Grassland was classified into two habitat zones of differing quality (PG1 and PG2) across the WGGA and NGGA (Figure 2; Figure 3),with differences in quality predominantly due to diversity and structure of the ground layer and the cover of weeds.

Habitat zone PG1 was the most commonly recorded habitat zone, and is an accurate representation of the modified native vegetation from both the WGGA and NGGA. Areas of PG1 are typically represented by at least 25% cover of a single species, either Wallaby-grass *Rytidosperma racemosum* var. *racemosum*, Short Wallaby-grass *Rytidosperma carphoides* and/or Veined Spear-grass. Habitat zone PG1 was typically recorded within

actively grazed paddocks, which were likely to have been subject to historical removal of embedded rock and cropping. The impact of historical and active cattle and sheep grazing throughout the NWGGA was evident through the low diversity of native herbs and forbs (i.e. palatable life-forms) that are likely to be favourably selected over relatively less palatable life-forms including the introduced grasses Serrated Tussock *Nassella trichotoma*, Chilean Needle-grass *Nassella neesiana* and Toowoomba Canary-grass *Phalaris aquatica.*

As such, these areas are also comprised of a high cover of exotic crop and pasture species such as Rye Grass *Lolium* spp., Wild Oat *Avena fatua*, Yorkshire Fog *Holcus lanatus*, Toowoomba Canary-grass and Paspalum *Paspalum dilatatum*. In addition to these common pasture species, the Weeds of National Significance (WoNS) Serrated Tussock and Chilean Needle-grass were prominent within the patches and the broader landscape (Plate 15; Plate 16).



Plate 15. Plains Grassland PG1 leading to Moorabool River (WGGA) (Ecology and Heritage Partners 19/12/2019).



Plate 16. Plains Grassland PG1 within the NGGA (Ecology and Heritage Partners 23/12/2019).

Habitat zone PG2 was recorded within the NGGA often as small isolated patches, or within relatively small farmland properties (Figure 2). The distinguishing characteristic of PG2 was an increase in native grassland species diversity, which included grassland species identified within PG1 with the addition of herbs such as Australian Bindweed *Convolvulus angustissimus*, Berry Saltbush *Atriplex semibaccata*, and Sheep's Burr *Acaena echinata* (Plate 17; Plate 18).

In addition to an increase in diversity, some patches of PG2 greater than 0.05 hectares supported a native perennial cover greater than 50% and at times up to 80% cover, which exceeds the condition threshold to be classified as the nationally listed ecological community *Natural Temperate Grassland of the Victorian Volcanic Plain* (NTGVVP) (Plate 19; Plate 20). The NTGVVP listed community is present within the NGGA, while patches within the WGGA did not meet the minimum condition threshold of at least 50% perennial native cover to constitute NTGVVP. These areas were also considered to meet the description for the State significant *Western (Basalt) Plains Grassland* vegetation community (DELWP 2021d).



Plate 17. Plains Grassland (PG2) within the NWGGA (Ecology and Heritage Partners Pty Ltd 23/12/2019).



Plate 18. Berry Saltbush within PG2 (Ecology and Heritage Partners Pty Ltd 23/12/2019).



Plate 19. NTGVVP recorded within NGGA in PG2 (Ecology and Heritage Partners Pty Ltd 23/12/2019).



Plate 20. Australian Bindweed recorded within NTGVVP (NGGA) (Ecology and Heritage Partners Pty Ltd 23/12/2019).

3.1.2.2 Creekline Grassy Woodland (WGGA)

Creekline Grassy Woodland typically comprises a eucalypt-dominated woodland to 15 metres tall with occasional scattered shrub layer over a mostly grassy/sedgy to herbaceous ground-layer. This EVC generally occurs on low-gradient ephemeral to intermittent drainage lines, on a wide range of suitably fertile geological substrates. These minor drainage lines can include a range of graminoid and herbaceous species tolerant of waterlogged soils and can at times resemble a linear wetland or system of interconnected small ponds (DELWP 2021c).

Within WGGA, Creekline Grassy Woodland was present within and surrounding Cowies Creek (WGGA, Figure 3) as a treeless grassy and aquatic herb creek line that occurs along low-gradient intermittent to ephemeral drainage lines. Common Blown Grass *Lachnagrostis filiformis*, and Creeping Monkey-flower *Thyridia repens* are the dominant understory species (Plate 21; Plate 22), with the western extent dominated by Common Reed *Typha australis*. The cover of native species formed up to 70% cover in areas fringing pooled water and

reduced to 30% cover as areas of the creek became drier. Overall, weed cover was high, with the noxious Spiny Rush *Juncus acutus* being the dominant weed, with other species such as Galenia *Galenia pubescens var. pubescens*, Toowoomba Canary-grass *Phalaris aquatica,* Serrated Tussock and Chilean Needle-grass also common. The noxious weed, and WoNS African Box-thorn *Lycium ferocissimum* was also scattered throughout the patch.



Plate 21. Creekline Grassy Woodland recorded within WGGA (Ecology and Heritage Partners Pty Ltd 05/02/2020).



Plate 22. Creeping Monkey-flower recorded within WGGA (Ecology and Heritage Partners Pty Ltd 05/02/2020).

3.1.2.3 Floodplain Riparian Woodland

Floodplain Riparian Woodland is generally described as an open eucalypt woodland to 20 metres tall over a medium to tall shrub layer with a ground layer consisting of amphibious and aquatic herbs and sedges. The EVC occurs along the banks and floodplains of larger meandering rivers and major creeks (DELWP 2021c).

Floodplain Riparian Woodland is present within WGGA immediately adjacent to the Moorabool River (Figure 3) comprising two habitat zones of differing quality (FRW1 and FRW2, Figure 2).

Habitat zone FRW1 is dominated by a River Red Gum *Eucalyptus camaldulensis* overstory with high number of Large Trees recorded throughout. The understory supported localised areas of dense shrubs including Silver Wattle *Acacia dealbata*, Hedge Wattle *Acacia paradoxa,* and Tree Violet *Melicytus dentatus* (Plate 23). Within the ground layer, there was a high weed cover predominantly represented by Yorkshire Fog, with scattered occurrences of the indigenous Common Tussock-grass *Poa labillardierei* (Plate 24).

Habitat zone FRW2 occurs as a treeless area represented by native grass cover similar in diversity as PG1. The decision to follow DELWP EVC modelling was made based on the patch being defined by the minimum cover of 25% Wallaby-grass and lacked any defining characteristic due to the evident disturbance of the site. As such, DELWP's EVC modelling was followed to define the ecotone between patches.



Plate 23. Floodplain Riparian Woodland within WGGA (Ecology and Heritage Partners 05/02/2020).



Plate 24. Floodplain Riparian Woodland within WGGA (Ecology and Heritage Partners 05/02/2020).

3.1.2.4 Current Wetlands

A total of 2.259 hectares of 'Current Wetland' is modelled by DELWP to occur within the NGGA (Figure 2a). It should be noted that the current wetland layer was also predominantly mapped as PG1 with some areas dominated by exotic vegetation predominantly Toowoomba Canary-grass *Phalaris aquatica*. An additional 8.12 hectares of Current Wetland is modelled to occur near along the southern boundary of the NGGA. This area is in a part of the NGGA where access was not granted. As such, it is not included in the formal totals of vegetation recorded in the NGGA.

3.1.2.5 Large Trees and Scattered Trees

Large Trees

A total of 102 Large Trees in patches – all River Red-gum, were recorded within the WGGA, all within habitat zone FRW1 adjacent to the Moorabool River (Figure 3a-3b). No Large Trees in patches were recorded within the NGAA.

Scattered Trees

Three scattered trees (Grey Box *Eucalyptus microcarpa*) were recorded within the NGGA (Figure 2), of which two were defined as small and one large as per the definitions detailed in the Guidelines (DELWP 2017b). Two Large scattered River Red-gum were recorded within the WGGA. The lack of scattered trees throughout the NWGGA is due to the majority of land being modelled and observed on site as Plains Grassland, a treeless EVC. It is also likely due to the broad-scale vegetation removal associated with historical agricultural land use within both the NGGA and WGGA.

A table of all large trees and scattered trees within the NWGGA is provided in Appendix 2.4.

3.1.2.6 Introduced and Planted Vegetation

The vast majority of both the WGGA and NGGA does not support native vegetation and was dominated by introduced flora species, predominantly as a direct result of historical and current farming practices. These practices have resulted in the removal and stockpiling of embedded rock, ploughing for crops, and seeding for

pasture (Plate 25). Some areas of embedded rock did persist, however they were predominately comprised of exotic pasture species (Plate 26). Planted Pine *Pinus pinaster* and Sugar Gums *Eucalyptus cladocalyx,* commonly occurred throughout the NWGGA as windrows and amenity plantings (Plate 27; Plate 28).

Non-native areas were dominated by pasture grasses and environmental weeds. Noxious weeds were dominant in several locations (Table 13), with Chilean Needle-grass and Serrated Tussock being particularly prevalent throughout. African Boxthorn was found along Cowies Creek and scattered throughout both the WGGA and NGGA.



Plate 25. Bare ground leading to Cowies creek surrounded by Chilean Needle Grass and African Boxthorn (Ecology and Heritage Partners Pty Ltd 19/02/2020).



Plate 26. Embedded rock surrounded by Yorkshire Fog within paddocks (Ecology and Heritage Partners Pty Ltd 23/12/2019).



Plate 27. Planted Pines as a windrow (Ecology and Heritage Partners Pty Ltd 19/02/2020).



Plate 28. Amenity planted Pine (Ecology and Heritage Partners Pty Ltd 23/12/2019).

3.1.3 Fauna Habitat

3.1.3.1 Exotic and Native Grasslands

Much of the NWGGA consists of paddocks which contain improved exotic pastures, likely to be used as a foraging resource by common generalist bird species which are tolerant of modified open areas. Fauna observed using this habitat included Australian Magpie *Cracticus tibicen*, Little Raven *Corvus mellori*, Welcome

Swallow *Hirundo neoxena*, Magpie-lark *Grallina cyanoleuca*, Willie Wagtail *Rhipidura leucophrys*, Common Starling *Sturnus vulgaris*, Eurasian Skylark *Alauda arvensis*, Banded Lapwing *Vanellus tricolor*, Masked Lapwing *Vanellus miles*, Australian White Ibis *Threskiornis moluccus,* Straw-necked Ibis *Threskiornis spinicollis*, Australasian swamphen *Porphyrio melanotus*, Eurasian Coot *Fulica atra*, Whistling kite *Haliastur sphenurus*, Nankeen kestrel *Falco cenchroides*, Brown Falcon *Falco berigora,* Wedge-tailed eagle *Aquila audax*, Eastern Grey Kangaroo *Macropus giganteus*, Eastern Blue-tongue Lizard *Tiliqua scincoides,* House Mouse *Mus musculus*, European Hare *Lepus europaeus* and European Rabbit *Oryctolagus cuniculus*

Several nocturnal fauna species were observed during nocturnal surveys, including Black Rat *Rattus rattus*, Red Fox *Vulpes vulpes*, Tawny Frogmouth *Podargus strigoides*, Common Eastern Froglet *Crinia signifera* and Eastern Banjo Frog *Limnodynastes dumerilii*.

These areas also provide habitat for reptiles such as the State significant Tussock Skink *Pseudemoia pagenstecheri*, which has recently (December 2019) been recorded by Ecology and Heritage Partners on multiple occasions within a site located adjacent to the Hamilton Highway. Although, no individuals were recorded within either the WGGA or NGAA, suitable habitat is present throughout the NWGGA and broader locality.

3.1.3.2 Woodlands and Scattered Trees

Although the majority of the NWGGA is typically treeless, planted vegetation provides moderate quality habitat for native fauna, and an important source of roosting, nesting and sheltering habitat for birds, mammals and reptiles in an otherwise modified landscape.

Large trees and tree hollows are also present within the WGGA which provides important habitat for native fauna. Arboreal mammals were observed to use trees within the NWGGA including Common Brushtail Possum *Trichosurus Vulpecula* and Common Ringtail Possum *Pseudocheirus peregrinus,* as well as birds which use the tree hollows for nesting such as Sulphur-crested cockatoo *Cacatua galerita*, Galah *Eolophus roseicapilla* and Red-rumped Parrot *Psephotus haematonotus*.

Many of the scattered eucalypts are relatively mature, providing an array of small, medium, large and very large hollows, bark fissures and crevices. These are likely to be relied upon for shelter and nesting by a range of hollow-dependent fauna including parrots, microbats, possums, gliders and owls.

A broad selection of bat species is likely to roost within trees where fissures or cracks are present and disused buildings associated with the NWGGA. Grey-headed Flying-fox *Pteropus poliocephalus* may occasionally forage over open and vegetated areas throughout the NWGGA as these species have been recorded within the local area (DELWP 2020).

Scattered trees provide foraging habitat for insectivorous and nectivorous birds as well as vantage points and nesting areas for diurnal and nocturnal raptors and other non-hollow dependent species including Australian Magpie *Cracticus tibicen* and Australian Raven *Corvus coronoides*. These trees also provide stepping stones for more mobile fauna moving through the NWGGA, enhancing landscape permeability for a wide range woodland birds, possums, reptiles, as well as predators such as raptors.

3.1.3.3 Aquatic Habitat

Multiple waterbodies in the form of artificial dams, along with Cowies Creek and the Moorabool River occur within the WGGA (Figure 4; Figure 5).

Cowies Creek and the Moorabool River, at points, provides quality habitat for aquatic and amphibious species through a diversity of structural fringing habitat such as tall reeds and grasses and sedges forming large tussocks (Plate 29; Plate 30; Plate 31; Plate 32). Where fringing vegetation occurs, it is typically in the form of exotic pasture grasses such as Toowoomba Canary-grass. Water quality was typically low with turbidity typically high. Species observed utilising waterways were restricted to Common Froglet *Limnodynastes dumerilii*, White-necked Heron *Ardea pacifica*, White-faced heron *Egretta novaehollandiae* and Pacific Black Duck *Anas superciliosa*.

Of the artificial water bodies present there was a clear lack of connectivity to natural aquatic habitats, and as such, it is highly unlikely these areas support a diversity of native species.



Plate 29. Cowies Creek (WGGA) (Ecology and Heritage Partners Pty Ltd 05/02/2020).



Plate 30. Cowies Creek (WGGA) (Ecology and Heritage Partners Pty Ltd 05/02/2020).



Plate 31. Moorabool River (WGGA) (Ecology and Heritage Partners Pty Ltd (06/12/2019).



Plate 32. Artificial waterbody east of Browns Road (Ecology and Heritage Partners Pty Ltd 06/12/2019).

3.2 Nationally Significant Values

Matters of National Environmental Significance (NES) are listed and protected under the EPBC Act. Matters of NES relating to biodiversity are discussed below in relation to the entire NWGGA based on the results of the PMST (DAWE 2021), desktop review of literature, and the results of ecological surveys.

3.2.1 Flora

The VBA contains records of 12 nationally significant flora species previously recorded within 10 kilometres of the NWGGA (DELWP 2021a) (Figure 10; Appendix 2.2).

The PMST nominated an additional 12 nationally significant flora species which have not been recorded in the locality but have the potential to occur (DAWE 2021; Appendix 2.2).

Of the 24 nationally significant flora species that are known to, or are predicted to occur within the locality (Appendix 2.2), six were considered to have a high likelihood of occurrence within the NWGGA (Table 19).

A single species, Adamson's Blown-grass, was historically recorded in 1995 within the WGGA study area, and in 2001 and 2002 adjacent to the WGGA in Cowies Creek (DELWP 2021a; Figure 11), however the record was searched for, but was not observed during the field assessments. However, Adamson's Blown-grass is to be assumed as present based on the presence of suitable habitat within Cowies Creek and relatively recent historical records (Section 3.2.1.5).

Based on the results of the desktop assessment and field assessments, it is considered highly unlikely that any additional nationally significant flora species occur within the accessible areas of the NWGGA due to highly modified condition of the understorey and ongoing land use of the site resulting in the absence of suitable habitats likely to support nationally significant flora.

In addition, there is an absence of previous records for several species within the broader locality (i.e. River Swamp Wallaby-grass, Trailing Hop-bush, Swamp Everlasting), and the NWGGA is well outside the known range of several species (i.e. Wimmera Rice-flower, Hoary Sunray, Leafy Greenhood, Green-striped Greenhood).

Furthermore, several nationally significant flora records were last recorded prior to 1950, indicating that these species are likely to be locally extinct. The likelihood of occurrence of nationally threatened species within the NWGGA is outlined in Appendix 2.2.

Table 19. Nationally significant flora with the highest likelihood of occurrence within the NWGGA

Species	Suitable habitat within the NWGGA	Closest known records
Spiny Rice-flower	Habitat for the EPBC Act-listed Spiny Rice-flower was identified within areas of Plains Grassland, and areas of embedded rock.	Approx. 1.3 kilometres east of NGGA adjacent to Heales Road.
Large-headed Fireweed	Likely habitat for the species is identified within areas of moderate to high quality plains grassland. Areas of embedded rock not supporting native vegetation have a moderate to low likelihood of occurrence	Approximately 8.4 kilometres east of the NGGA, and 8.7 kilometres west of the WGGA.
Matted Flax-lily	Likely habitat for the species is identified within areas of moderate to high quality plains grassland. Areas of embedded rock not supporting native	Approximately 9.5 kilometres east of the NGGA, and 9.6 kilometres west of the WGGA.

Species	Suitable habitat within the NWGGA	Closest known records
	vegetation have a moderate to low likelihood of occurrence.	
Clove Glycine	Likely habitat for the species is identified within areas of moderate to high quality plains grassland. Areas of embedded rock not supporting native vegetation have a moderate to low likelihood of occurrence.	Approximately 13 kilometres west of the WGGA.
Button Wrinklewort	Likely habitat for the species is identified within areas of moderate to high quality plains grassland. Areas of embedded rock not supporting native vegetation have a moderate to low likelihood of occurrence.	Approximately 6 kilometres east of the NGGA, and 8.8 kilometres west of the WGGA.
Adamson's Blown-grass	Likely habitat for the species is identified within Creekline Grassy Woodland vegetation within the area.	Previous records within WGGA (Cowies Creek Figure 10).

3.2.1.1 Large-headed Fireweed

Large-headed Fireweed has the potential to occur within areas of relatively undisturbed Plains Grassland with Kangaroo Grass present (Figure 5a; Figure 5b) (DAWE 2021a). Few areas of relatively undisturbed Plains Grassland supporting Kangaroo Grass was observed within the NWGGA.

Despite targeted surveys being undertaken at an appropriate time of year when the species is generally known to be flowering, no specimens of Large-headed Fireweed were recorded within the NWGGA.

The dominant grassland species was Wallaby-grass often defined by the minimum 25% native perennial cover, which is not considered likely habitat for the species, and the existing condition of habitat was predominantly cleared or showed signs of historical clearing and high weed invasion. As such, habitat for the species is considered marginal and given the results of the targeted surveys the species is considered highly unlikely to occur within the assessed areas of the NWGGA.

3.2.1.2 Matted Flax-lily

The species has the potential to persist within areas of Plains Grassland and open woodland habitats recorded within the NWGGA (Figure 5a; Figure 5b). However, the likelihood of occurrence was considered low within highly degraded areas of grassland not supporting embedded rock, typically identified as PG1 (Figure 2, Figure 3). Areas of higher quality grassland (PG2, NTGVVP) and areas combining native vegetation and embedded rock were considered likely habitat for the species (Figure 5a; Figure 5b).

Surveys were conducted at five metre intervals within areas of moderate to high quality habitat (DES 2010).

Despite targeted surveys being undertaken at an appropriate time of year when the species is generally known to be flowering, no specimens of Matted Flax-lily were recorded within the NWGGA (Figure 8a; Figure 8b).

Several patches of Plains Grassland (habitat zone PG2) provide potential habitat for the species, as well as some other non-native areas, such as areas of embedded rock within NGGA. However, potential habitats outside of these areas have been heavily modified through agricultural activities, and potential habitat is either highly modified or no longer present as observed within WGGA.

As such, habitat for the species is considered marginal and given the results of the targeted surveys the species is considered highly unlikely to occur within the assessed areas of the NWGGA.

It is recommended that CoGG further investigate the possibility to gain access to parcels that have not been surveyed to identify the presence of potential habitat for Matted Flax-lily. If potential habitat for the species is observed, then targeted surveys should be undertaken in accordance with the relevant survey guidelines.

3.2.1.3 Clover Glycine

Clover Glycine has the potential to occur within areas of higher quality Plains Grassland recorded within the NGGA (PG2, NTGVVP) (Figure 5a; Figure 5b), which were surveyed at a spacing of approximately five metres between ecologists (DoE 2013b). Despite such areas supporting suitable habitat, the impact of historical and active grazing throughout the study area was evident from both native and introduced herbivores and cattle, which was noted during the surveys. However, biomass was still relatively high within areas of PG2 and NTGVVP, with the seed heads of grasses present and able to be identified. As such, the presence of grazing was not considered to limit the findings of the survey.

Despite targeted surveys being undertaken at an appropriate time of year when the species is generally known to be flowering, no specimens of Clover Glycine were recorded within the NWGGA (Figure 8a; Figure 8b).

Given the results of the targeted surveys and the ongoing threats to the species observed within the NWGGA, habitat for the species is considered marginal and the species is considered highly unlikely to occur within the assessed areas of the NWGGA.

3.2.1.4 Button Wrinklewort

The species grows in grassland and woodland communities primarily associated with Kangaroo Grass with an open distribution between tussocks (Morgan 1995).

Despite targeted surveys being undertaken at an appropriate time of year when the species is generally known to be flowering, no specimens of Button Wrinklewort were recorded within the NWGGA (Figure 8a; Figure 8b).

In consideration of the identified threats to Button Wrinklewort within the NWGGA (i.e. urban development, physical disturbance of sites, weeds, competition from native grasses, heavy grazing, unsuitable fire regimes, demographics of small populations, (OEH 2012), habitat for the species is considered marginal and given the results of the targeted surveys the species is considered highly unlikely to occur within the assessed areas of the NWGGA.

3.2.1.5 Adamson's Blown-grass

The species has the potential to persist within or adjacent to wetlands and drainage lines located within the NWGGA (Figure 5a; Figure 5b). Surveys were conducted utilising five metre transects within areas of potential habitat (Cowies Creek corridor, drainage lines).

Although several parcels containing potential habitat were being grazed at the time of the targeted surveys, biomass was still relatively high within the drainage lines with the seed heads of grasses present and able to be identified. As such, the presence of grazing was not considered to limit the findings of the survey.

Despite targeted surveys being undertaken at an appropriate time of year when the species is generally known to be flowering and readily detectable, no specimens of Adamson's Blown-grass were recorded within the NWGGA (Figure 8a; Figure 8b).

Potential habitat adjacent to Cowies Creek was highly modified and dominated by exotic grasses including Toowoomba Canary-grass and Kikuyu *Pennisetum clandestinum.* The drainage lines contained little native vegetation and were generally comprised of improved and exotic pasture. Further, there was little evidence to indicate that the drainage lines had recently supported standing water, with any areas subject to waterlogging dominated by Toowoomba Canary-grass or Rush *Juncus* sp.

Given the known threats to the species that are present within the NWGGA, including a high cover of annual and perennial weeds within or adjacent to areas of potential habitat, ongoing agricultural disturbance (including cropping, grazing and vegetation clearance), as well as altered hydrological regimes (Murphy 2010), it is considered that existing habitat quality for the species is marginal.

Although the species was not recorded during the targeted survey effort, due to the presence of suitable habitat (albeit marginal), and relatively recent historical records, the species is assumed to be present within habitats adjacent to the Cowies Creek riparian corridor.

3.2.1.6 Spiny Rice-flower

The species was considered to have the potential to occur within patches of native vegetation (i.e. Plains Grassland EVC) and areas supporting embedded rock (Figure 5a; Figure 5b).

Within the NGGA and parts of the WGGA, biomass levels were high, with Chilean Needle-grass and Toowoomba Canary-grass particularly dominant outside patches of native vegetation resulting in little inter-tussock space being available for Spiny Rice-flower to co-exist.

Most habitats within the WGGA were comprised of improved pasture, and combined with agricultural land use, ongoing disturbance (grazing, slashing) high biomass, no recent evidence of fire and little to no inter-tussock space, the assessed areas exhibited few of the preferred habitat attributes of the species (DEWHA 2009a).

Despite systematic targeted surveys (a total of 92 person days) within all accessible areas of potential habitat (Figure 5a; Figure 5b) during the known flowering period, when the species was known to be flowering within the locality, no Spiny Rice-flower were detected (Figure 8a; Figure 8b).

Based on the results of the targeted survey, site condition and proximity and distribution of previous records, there is considered to be a low likelihood that the assessed areas of the NWGGA supports a population of Spiny Rice-flower.

A summary of survey dates, parcels surveyed, and survey effort is provided in Appendix 2.5.

3.2.1.7 Other Nationally Significant Flora and Unassessed Areas

It is acknowledged that approximately 33.6% of the NGGA and approximately 13.1% of the WGGA has not been subject to on-ground assessments, and as such, the absence of nationally significant flora species from these areas cannot be accurately determined. Based on the landscape context, highly modified, agricultural nature of the NWGGA and extent of previous vegetation removal, the likelihood of any additional nationally significant flora species occurring within the assessed areas of the NWGGA is considered low due to the absence of suitable habitat and lack of records in close proximity (Appendix 2.2).

However, it is recommended that CoGG further investigate the possibility to gain access to parcels that have not been surveyed to determine the presence or not of potential habitat for any nationally significant flora

species. If potential habitat for significant flora species is observed, then targeted surveys should be undertaken in accordance with the relevant survey guidelines.

3.2.2 Fauna

The VBA contains records of 27 nationally significant fauna species previously recorded within 10 kilometres of the NWGGA (DELWP 2021a) (Appendix 3.2) (Figure 11). The PMST nominated an additional 29 nationally significant species (including migratory and/or marine) which have not been previously recorded but have the potential to occur in the locality (DAWE 2021).

Of the 56 nationally significant fauna species that are known to, or are predicted to occur within the locality, five were considered to have a moderate or higher likelihood of occurrence within the NWGGA (Table 20).

The NWGGA supports general habitat features consistent with those preferred by the Grassland Earless Dragon *Tympanocryptis pinguicolla* (i.e. basaltic plains grassland). The VBA contains 'incidental' historical records (1990) of the species located approximately 15 kilometres north-east of the NGGA near the You Yangs (DELWP 2021a). However, intensive trapping surveys at the location since 1994 have failed to record the species or confirm the incidental sightings as being the Grassland Earless Dragon (Robertson and Evans 2012).

Although formerly relatively widespread between Bathurst in NSW to Geelong, Victoria, the current known distribution is restricted to two small areas within the ACT and the adjacent parts of the southern highlands in NSW, with the species now considered likely to be extinct within Victoria (Robertson and Evans 2012).

Given the presence of several known threats to the species, (i.e. grazing, weed invasion, rock removal, presence of introduced animals), and the likely extinction of the species in Victoria, it is considered that the species is highly unlikely to persist within the NWGGA.

The cropped paddock and native and non-native grasslands within the NWGGA contain potential habitat (albeit suboptimal) for the nationally significant Plains Wanderer *Pedionomus torquatus*, particularly post-harvest when these areas structurally resemble sparse, open native grasslands. However, much of the NWGGA supports swards of dense grass (i.e. Chilean Needle-grass) comprising high biomass, with the species known to avoid such habitat types (DoE 2016).

In addition, the Geelong region is not a strong-hold or supports core habitat for Plains Wanderer, with the Riverina region of Southern NSW and north-central Victoria the two main areas of primary and secondary habitat for the species (DoE 2016). As such, the use of habitat within the NWGGA by Plains Wanderer is highly unlikely (i.e. a vagrant visitor to the study area).

Previous records of Macquarie Perch *Macquaria australasica* and Yarra Pygmy Perch *Nannoperca obscura* are located immediately adjacent to the WGGA and although the most recent records are from 1981 and 2009 respectively (DELWP 2021d), both species have the potential to opportunistically utilise habitats within this region of the Moorabool River.

Based on the results of the desktop assessment and field assessments, it is highly unlikely that any additional nationally significant fauna occur within the assessed area of the NWGGA due to highly modified condition of the understorey and ongoing land use of the site resulting in the absence of suitable habitats likely to support nationally significant species. The likelihood of occurrence of nationally threatened species within the NWGGA is outlined in Appendix 3.2.

Table 20. Nationally significant fauna with the highest likelihood of occurrence within the NWGGA

Species	Suitable habitat within the NWGGA	Closet known records
Striped Legless Lizard	Areas of suitable tussock structure, cracking soils and embedded rock without major disturbance from ploughing.	Immediately adjacent to the NGGA north eastern boundary
Growling Grass Frog	Still or water flowing waterbodies with emergent vegetation	Cowies Creek approximately 700 metres east of WGGA and 2 kilometres south of NGGA
Golden Sun Moth	Areas supporting a moderate cover (i.e. 20-40%) of Wallaby-grass, Spear-grass and other native perennial species	Immediately adjacent to the NGGA north eastern boundary
Australian Grayling	Suitable habitat within Cowies Creek and Moorabool River	Moorabool River approximately 6 kilometres south of WGGA
Little Galaxias	Suitable habitat within Cowies Creek and Moorabool River	Historical records east of Melbourne

3.2.2.1 Striped Legless Lizard

Areas within the NWGGA support suitable habitat for Striped Legless Lizard, particularly in areas that support native grassland and secondary grasslands with cracking soils, and surface or embedded rock which the species relies on for habitat. Although some discrete areas of embedded rock are still present, most of the NWGGA has either been cropped or is highly disturbed (i.e. dominated by exotic grasses with an absence of cracking soils).

Targeted surveys commenced on 29 September and were completed on 30 November 2020, with a total of 77 tile grids checked eight times, comprising a total of 616 tile checks in total (Appendix 4).

Forty-five individual Striped Legless Lizards were recorded within the NGGA under 10 different tile grids (Plate 33; Plate 34). Twelve Striped Legless Lizard were recorded under Grid #54, eight were recorded under Grids #64 and 52, while Grids #77 and 66 had five and four Striped Legless Lizard, respectively (Figure 4a; Figure 6a; Table 21; Appendix 4.1).

Despite targeted surveys being undertaken during a suitable time of the year (i.e. between September and December) no Striped Legless Lizard were recorded in the WGGA.

Table 21. Summary of Striped Legless Lizard captures within the NGGA.

Grid #	28	29	43	52	54	64	66	70	76	77
Total number of Striped Legless Lizard	3	1	1	8	12	8	4	1	2	5

Sites where the species was recorded generally represent the highest quality habitat for Striped Legless Lizard within the NGGA. These areas supported a high cover of surface rock, cracking soils and tussock-forming grasses providing inter-tussock space. The high cover of surface rock at these sites also precludes regular slashing, which maintains a higher biomass and dense tussock structure throughout the year.

Striped Legless Lizard is known to have a very small home range (Robertson and Smith 2010) and has been documented to move as little as four square metres per year (O'Shea 2005). Given the limited dispersal range, contiguous habitat types were delineated based on habitat quality, and separated where a physical barrier (i.e. road, building, solid fences), or area of unsuitable habitat exceeded a width of 30 metres (DSEWPAC 2011a).

Based on the location of the confirmed records of the species and quality and extent of habitat, a total of 103.89 hectares of confirmed Striped Legless Lizard habitat is present within the NGGA (Figure 7). An additional 83.6 hectares of suitable habitat (i.e. comprising predominantly native grassland with cracking soils and surface rock) is also present. Although the species was not recorded in these areas, this habitat is still considered suitable, and as per the referral guidelines for the species (DSEWPaC 2011a), if the species is detected during surveys, then all suitable habitat should be considered as occupied. This equates to a total area of suitable Striped Legless Lizard habitat of 187.49 hectares.

An additional 207.25 hectares of potential habitat (low quality exotic grasslands, discrete areas of surface rock, highly disturbed) has been mapped. Although this area supports some suitable habitat characteristics (occasional areas of surface rock), this area exhibits higher levels of agricultural disturbance, contains a relatively higher cover of non-tussock, non-native ground cover resulting in reduced inter-tussock space, and is located in areas where soil compaction is more evident (i.e. reduced capacity for cracking soils).

As such, given the results of targeted surveys, as well as the small home range of the species, there is considered to be a low likelihood that a population of the species is present within areas of low quality potential habitat (Figure 7). Therefore, this low quality potential habitat is currently not assumed to be occupied by a population of Striped Legless Lizard.

Several other species were recorded during the targeted surveys and are generally common through the locality, including the native Eastern Blue-tongue Lizard *Tiliqua scincoides scincoides*, Garden Skink *Lampropholis guichenoti*, Marbled Gecko, Brown Snake *Pseudonaja textilis,* and Spotted Marsh Frog *Limnodynastes tasmaniensis*, and the introduced House Mouse *Mus musculus*.

Within the WGGA, the removal of native vegetation, high levels of grazing, pasture improvement and cultivation has contributed to the decline of high quality habitat for the species. Based on the location of existing records, results of the targeted surveys and condition of potential habitat (i.e. general lack of tussock grasses, absence of embedded rock, ground disturbance), it is considered highly unlikely that a population of Striped Legless Lizard is present within the WGGA.

Survey dates, weather conditions and the presence of Striped Legless Lizard is provided in Appendix 4.



Plate 33. Striped Legless Lizard recorded at Grid 54



Plate 34. Striped Legless Lizard recorded at Grid 64

3.2.2.2 Growling Grass Frog

The initial survey detected approximately 30 calling males of the species within Cowies Creek, generally localised in larger areas of pooling water (Plate 35; Plate 36). This area was then used as a reference site during subsequent surveys to confirm that the species was active/calling immediately prior to undertaking the survey within the WGGA. The species was both observed and heard to be calling at this location on multiple occasions, which indicates that the timing of the targeted surveys were appropriate to detect species presence within the WGGA.

Moorabool River

Despite targeted surveys bring undertaken during the core breeding period for the species, and with the species known to be active within the locality (Cowies Creek), no Growling Grass Frogs were identified during targeted surveys along the Moorabool River. While the Moorabool River corridor could potentially be used by the species opportunistically during dispersal activities, the results of targeted surveys indicate there is a low-moderate likelihood that an extant population of Growling Grass Frog currently occurs along the Moorabool River adjacent to the WGGA. During the targeted surveys two other frog species were recorded (Common Froglet and Eastern Banjo frog) (Appendix 3.1).

Cowies Creek

Approximately 35 Growling Grass Frog were recorded calling within Cowies Creek (within the WGGA) on 6 December 2019 and five individuals were observed further north while spotlighting on 12 January 2020 with several additional specimens (approximately 10) heard via call-playback. An individual was also incidentally captured in a fyke net within this stretch of Cowies Creek (Plate 37). Taking into consideration the known distribution of the species within Cowies Creek, the distribution of key habitat attributes along the waterway and the potential for the species to utilise the waterway, Cowies Creek is considered to support an important population of the species, and acts as an important habitat corridor throughout the WGGA (Figure 6b).

Habitat Assessment

Sites occupied by Growling Grass Frog during the surveys supported a high cover of fringing native plant species (i.e. sedges and grasses), together with exotic pasture and weed species (e.g. Toowoomba Canary grass, Chilean-Needle grass and African Boxthorn), and low to moderate cover of aquatic vegetation (i.e.

submerged, emergent and floating vegetation). Male Growling Grass Frogs were observed using floating 'algal mats' within the waterbody.

Water quality at Site 4 was high within areas of known habitat. Temperature (ºC) 18.8 was well within the known range for the species. Dissolved Oxygen levels were high and is likely a reflection of temperature, the high coverage of fringing vegetation and presence of emergent vegetation. Conductivity and salinity were low. The water within known Growling Grass Frog was considered fresh, whilst pools upstream were considered saline. pH was close to neutral at 8.73 and turbidity was moderate.

A summary of weather conditions and the results of the habitat assessment are provided below (Table 22 and Table 23 respectively).

Table 22. Growling Grass Frog Survey Weather Conditions.

Survey/ Date	Weather conditions						Species
	Survey Temp Cº	Wind direction	Wind speed (km/hr)	Relative Humidity (%)	Cloud Cover (%)	Rain	
Moorabool River							
13/12/2019	19.1	SW	30	96	0	0	Eastern Banjo Frog, Common Eastern Froglet
18/02/2020	16.3	SW	18	99	100	light	None
19/02/2020	15.4	SW	17	92	50	0	None
Cowies Creek							
06/12/2019	14.2	W	19	78	0	0	Growling Grass Frog (approx. 35), Common Eastern Froglet
15/01/2020	18.5	SSE	20	94	0	0	Growling Grass Frog (approx. 15), Common Eastern Froglet

Note: Weather data taken from Bureau of Meteorology

Table 23. Habitat Assessment for Growling Grass Frog.

Hydro period	Instream Pools	Offstream Waterbodies	Habitat Quality	Terrestrial habitat adjacent to waterbody	Aquatic Veg % Cover
Moorabool River					
3	Present	Present	Moderate	Exotic vegetation, some native grasses and reeds	20%-100% fringing, 30%-70% emergent,
Cowies Creek					
<u>Known Habitat</u>					
3	Present	N/A	High	Exotic vegetation, some native sedges	80%-100% fringing, 10%-30% emergent, algal mats present
<u>Potential Habitat</u>					
3	Present	N/A	Low (poor water quality)	Exotic vegetation, some native sedges	80%-100% fringing, 10%-30% emergent.



Plate 35. 100 % fringing vegetation coverage by natives (Ecology and Heritage Partners Pty Ltd 16/01/2019).



Plate 36. Growling Grass Frog habitat within the WGGA (Ecology and Heritage Partners Pty Ltd 16/01/2019



Plate 37. Mature Growling Grass Frog caught within the WGGA (Ecology and Heritage Partners Pty Ltd 29/01/2019).

3.2.2.3 Golden Sun Moth

2019/20 Survey Season

Golden Sun Moth were confirmed flying at a reference site in Bacchus Marsh (Bences Road) prior to undertaking surveys within the NWGGA. A large population was subsequently recorded flying within the NGGA at 35 Staceys Road, Lovely Banks within areas of suitable habitat and adopted as the reference site. This site was checked prior to undertaking Golden Sun Moth surveys within the NGGA and WGGA to confirm the species was flying and conditions were suitable for the detection of the species.

Surveys for Golden Sun Moth were generally undertaken in accordance with the recommended survey guidelines detailed in the significant impact guidelines for the species (DEWHA 2009b), and the *Biodiversity*

Precinct Planning Structure Kit (DSE 2010). However, due to the suboptimal weather conditions on several days during the known flight season, some surveys were undertaken outside the optimal survey conditions. The limitations and justification for undertaking surveys during suboptimal conditions is detailed in Section 2.5.4.

Targeted surveys focussed on areas of potential habitat comprising uncropped land within the NWGGA. This included the areas mapped as Plains Grassland as well as predominantly introduced vegetation, where a high cover of the species preferred food plants (Wallaby-grass, Chilean Needle-grass) occurred.

Systematic targeted surveys identified multiple populations and isolated occurrences of the Golden Sun Moth within the NGGA (Table 24; Figure 4).

A summary of the confirmed survey results is provided in Table 24, and unsuccessful surveys within Table 25.

Table 24. Confirmed (recorded) Golden Sun Moths Surveys within the NGGA (2019/2020 Survey Season).

Survey #	Date	Survey times	Temperature (C) #	Wind (km/hr) Direction	Cloud cover (%)	No. of days since rain	Parcel # (Figure 4a; Figure 4b)	# GSM per parcel
1	5/12/2019	1000-1600	22.8	15 NW	80	1	4, 6, 7	4- 24 6- 103 7- 19
2	6/12/2019	1000-1600	20.2	15 NW	30	2	2, 4, 6, 7	2- 12 4- 10 6- 121 7- 9
3	9/12/2019	1000-1600	38.9	9 NE	10	5	1, 2, 3	1- 6 2- 9 3- 16
4	10/12/2019	1000-1600	18.9	15 SSW	60	6	1, 3	1- 10 3- 8
5	11/12/2019	1000-1600	19.1	13 S	35	1*	1, 2	1- 8 2- 17
7	12/12/2019	1000-1600	19.6	20 SW	35	2	2, 4, 6	2- 11 4- 11 6- 98
9	20/12/2019	1000-1600	32.8	11 NE	10	10	1, 2, 3, 4, 6	1- 4 2- 2 3- 3 4- 3 6- 84
15	22/01/2020	1000-1600	31.6	24 N	20	1	2	2- 6

Note: Weather data source: http://www.bom.gov.au/; * 0.2 millilitres of rain fell the afternoon of 10/12/2019; # Temperature at the commencement of surveys.

Table 25. Unsuccessful Golden Sun Moth survey results (NWGGA) (2019/20 Survey Season).

Survey #	Date	Survey times	Temperature (C) #	Wind (km/hr) Direction	Cloud cover (%)	No. of days since rain	Parcel # (Figure 4a; Figure 4b)	Reference Site (Site 6)
1	05/12/2019	1000-1600	22.8	15 NW	80	1	NGGA: 1-3	Yes
2	06/12/2019	1000-1600	20.2	15 NW	90	2	NGGA: 5, 7	Yes
3	09/12/2019	0900-1500	38.9	9 NE	0	5	WGGA: 4-5	Yes
4	10/12/2019	1000-1600	18.9	15 SSW	95	6	NGGA: 4-8	Yes
6	12/12/2019	1000-1600	19.6	20 SW	85	2	WGGA: 1-5	Yes
8	18/12/2019	0900-1600	41.3	16 W	5	8	NGGA:8 WGGA: 6	Yes
9	20/12/2019	1000 – 1600	32.8	11 NE	10	10	NGGA: 5, 7	Yes
10	09/01/2020	1000-1600	29.6	21 SE	0	1	WGGA: 1-3	Yes
11	10/01/2020	0900-1500	33.0	9 SSW	40	2	WGGA:4-5	Yes
12	13/01/2020	1200-1600	32.9	19 NE	5	4	WGGA:6	Yes
13	14/01/2020	1000-1500	27.9	14 SSE	5	5	WGGA: 1-6	Not Checked
14	15/01/2020	0900-1500	22.8	6 SE	0	6	WGGA: 6	Yes
16	23/01/2020	1000-1200	20.6	10 NW	10	2	NGGA: 1,3	Not Checked
17	29/01/2020	1000-1600	29.5	13 NE	0	5	NGGA: 4-8 WGGA: 6	Not Checked ^

Note: Weather data source: http://www.bom.gov.au/; * 0.2 millilitres of rain fell the afternoon of 10/12/2019; ^ Confirmed flying in Bacchus Marsh; # Temperature at the commencement of surveys.

The largest population of Golden Sun Moth was recorded at 75 Stacey's Road, Lovely Banks (Parcel 6), with a total of 406 individuals recorded over multiple visits. Properties adjacent to this population also contain suitable habitat for the species, due the presence of a known population as previously recorded by Ecology and Heritage Partners, and the presence of a high density of the species preferred food plants (Chilean Needle-grass) (Figure 4).

A further 188 individuals were recorded across the NGGA (Figure 6a) in eight parcels. No Golden Sun Moth were recorded within the WGGA.

Habitat patches PG2 generally displayed the most suitable habitat for Golden Sun Moth due to the presence of higher quality vegetation and the increased abundance of the species' preferred food plant, Wallaby-grass, in combination with Chilean Needle-grass. Despite the presence of Wallaby-grass in some patches, habitat quality was considered sub-optimal for the species due to the relatively low coverage of preferred native grass

species and ground cover generally consisting of less than 10% Wallaby-grass. Further, areas considered as unsuitable habitat showed clear signs of recent disturbance from ploughing.

2020/21 Survey Season

Golden Sun Moth were confirmed flying at a reference site in Bacchus Marsh (Bences Road) prior to undertaking surveys within the NWGGA. A large population was subsequently recorded flying within the NGGA at 155 Robbs Road, Lovely Banks (Parcel 14) and adopted as the reference site for the remainder of the survey season. This site was checked prior to undertaking Golden Sun Moth surveys within the NGGA and WGGA to confirm the species was flying and conditions suitable for the detection of the species.

Surveys for Golden Sun Moth were undertaken in accordance with the recommended survey guidelines detailed in the significant impact guidelines for the species (DEWHA 2009c), and the *Biodiversity Precinct Planning Structure Kit* (DSE 2010), and summarised in Section 2.3.3.3.

Targeted surveys focussed on areas of potential habitat comprising uncropped land within the NWGGA that were not assessed during the 2019/20 survey season (Parcels 9-17). This included the areas mapped as Plains Grassland EVC as well as predominantly introduced vegetation, where a higher cover of the species preferred food plants (Wallaby-grass, Chilean Needle-grass) occurred.

Systematic targeted surveys identified multiple populations and isolated occurrences of the Golden Sun Moth within the NGGA, with 1906 Golden Sun Moth recorded (Table 26; Figure 6a). No Golden Sun Moth were recorded within the WGGA (Figure 6b).

The limited dispersal ability of the Golden Sun Moth means that any areas of potential habitat separated by 200 metres or more are effectively isolated and should be considered as separate habitat area (DEWHA 2009c). Further, isolated sites where the species has gone extinct are unlikely to be naturally recolonised (DEWHA 2009b).

Table 26. Golden Sun Moth survey results (NWGGA) (2020/2021 Survey Season).

Survey #	Date	Survey times	Temperature (C)	Wind(km/hr) Direction	Cloud cover (%)	No. of days since rain	Parcel # (Figure 4a; Figure 4b)	# GSM per parcel
1	27/11/2020	1000-1600	19.6	21 W	30	3	9, 10, 11, 13, 16, 17	9- 6 10- 64 11- 0 13- 7 16- 19 17- 33
2	4/12/2020	1000-1600	17.9	16 SW	20	4	10, 12, 14, 15, 16, 17	10- 78 12- 0 14- 117 15- 0 16- 55 17- 39
3	5/12/2020	1000-1600	22.1	10 NW	80	5	9, 11, 13, 7W, 2W	9- 39 11- 17

Survey #	Date	Survey times	Temperature (C)	Wind(km/hr) Direction	Cloud cover (%)	No. of days since rain	Parcel # (Figure 4a; Figure 4b)	# GSM per parcel
								13- 20 7W- 0 2W- 0
4	9/12/2020	1000-1600	18	23 W	70	1	10, 12, 14, 15, 16, 17, 18	10- 98 12- 0 14- 165 15- 12 16- 108 17- 95 18- 41
5	12/12/2020	1000-1300	20.3	10 SE	40	4	9, 11	9- 41 11- 27
6	14/12/2020	1000-1300	26.4	20 NW	20	6	7W, 2W, 11	11- 34 7W- 0 2W- 0
7	15/12/2020	1000-1600	28.5	7 SW	10	7	12, 13, 14, 15,	12- 0 13- 15 14- 208 15- 31
8	16/12/2020	1000-1600	18.3	9 SW	80	8	10, 16	10- 86 16-65
9	17/12/2020	1000-1600	21.7	11 W	70	9	7W, 2W, 9, 12, 15, 17	7W- 0 2W- 0 9- 39 12- 0 15- 41 17- 68
10	27/12/2020	1000-1600	27.6	26 SW	80	4	7W, 2W, 13, 14	7W- 0 2W- 0 13- 19 14- 216

Based on the targeted surveys undertaken across the 2019/20 and 2020/21 flight seasons, no Golden Sun Moth were recorded within WGGA, while a total of 693.69 hectares of confirmed Golden Sun Moth habitat was recorded within the NGGA. Where Golden Sun Moth was recorded, confirmed habitat was mapped where all areas of contiguous habitat supporting the species preferred food plants (i.e. moderate or higher cover of Wallaby-grass and/or Chilean Needle-grass) were present (Figure 9a).

3.2.2.4 Australian Grayling and Little Galaxias

Despite surveys being undertaken at an appropriate time of year and in accordance with the *Survey guidelines for Australia's threatened fish* (DSEWPaC 2011d), no Australian Grayling or Little Galaxias were detected at any

survey sites within the WGGA. Targeted surveys detected a variety of fish species within both waterbodies consisting of eight native and three introduced species (Table 27).

Moorabool River

Ecological surveys

Habitat within the Moorabool River was of high quality and included the range of requirements needed to support a resident population of Australian Grayling (e.g. alternating pools and riffles, instream snags, good water quality) (Plates 38-43). The number of historical upstream records (Figure 11) suggests that the species previously utilised the river on a regular basis. A constructed weir spans the Moorabool River within the western stretch of the WGGA and would form a physical barrier to upstream movement of the species. Accordingly, targeted surveys were undertaken both upstream and downstream of the weir to increase the likelihood of detecting the species. Photos of those fish species detected during targeted surveys are provided in Appendix 3.3.

Table 27. Summary of fish species detected during targeted surveys (Moorabool).

Scientific Name	Common Name
Above Weir	
Native	
Short-finned Eel	*Anguilla australis*
Australian Smelt	*Retropinna semoni*
Flat-headed Gudgeon	*Philypnodon grandiceps*
Common Galaxias	*Galaxias maculatus*
Freshwater Shrimp	*Paratya australiensis*
Introduced	
Common Carp	*Cyprinus carpio*
Below Weir	
Native	
Flat-headed Gudgeon	*Philypnodon grandiceps*
River Blackfish	*Gadopsis marmoratus*
Tupong	*Pseudaphritis urvilli*
Southern Pygmy Perch	*Nannoperca australis*
Freshwater Shrimp	*Paratya australiensis*
Introduced	
Common Carp	*Cyprinus carpio*
Brown Trout	*Salmo trutta*
Mosquito Fish	*Gambusia holbrookii*

Water Quality

Water quality within the Moorabool was high and within the known tolerances for Australian Grayling (Table 28). Given the relatively high flow rate and water level within the Moorabool it is considered unlikely that

water quality fluctuates significantly between sites. Temperature (17.2ºC) was as expected for a water body of this size and at this time of year (Table 28). Dissolved oxygen was within the range for a healthy river system and is likely a reflection of the abundance of emergent and submerged vegetation, and the presence of riffles and rapids which oxygenate the water. Conductivity was low at 1133 microseimen per centimetre and the water was mildly alkaline with a pH of 8.98. Turbidity was also low at 9.9 NTU. All which indicate a healthy river system.

Table 28. Water Quality within the Moorabool River.

Parameter	Measurement
Temperature (ºC)	17.2
Dissolved Oxygen (%)	34.8
Dissolved Oxygen (mg.L^{-1})	3.33
Conductivity (µS.cm^{-1})	1133
Salinity (ppt)	0.67
pH	8.98
Turbidity (NTU)	9.9



Plate 38. High quality Australian Grayling habitat within the Moorabool River (Ecology and Heritage Partners Pty Ltd 12/12/2019).



Plate 39. High quality Australian Grayling habitat within the Moorabool River (Ecology and Heritage Partners Pty Ltd 12/12/2019).



Plate 40. High quality Australian Grayling habitat within the Moorabool River (Ecology and Heritage Partners Pty Ltd 12/12/2019).



Plate 41. Backpack electrofishing downstream of the weir in high quality Australian Grayling habitat (Ecology and Heritage Partners Pty Ltd 12/12/2019).



Plate 42. High quality Australian Grayling habitat within the Moorabool River (Ecology and Heritage Partners Pty Ltd 12/12/2019).



Plate 43. High quality Australian Grayling habitat within the Moorabool River (Ecology and Heritage Partners Pty Ltd 12/12/2019).

Cowies Creek

Ecological surveys

Habitat within Cowies Creek was poor and lacked many of the key habitat characteristics associated with Australian Grayling (Plate 44; Plate 45; Table 30). The waterway consisted of a series of stagnant pools separated by stretches of dry creek bed, which would inhibit the ability for fish species to migrate between pools. Water quality varied between pools but was typically poor and no snags were present within the waterway. The lack of records within the waterway suggests that Cowies Creek has been under surveyed in the past. Common Yabby *Cherax destructor* was caught in all pools surveyed. One regionally significant species the Eastern Long-necked Turtle *Chelodina longicollis* was caught in a fyke net in the western reaches of Cowies Creek. All fish species were absent from this pool. A large number of Mosquito Fish were present within pools in the mid reaches of the waterway with natives starting to appear as salinity levels dropped in the lower reaches of the waterway (Table 29).



Plate 44. Degraded habitat within Cowies Creek (Ecology and Heritage Partners Pty Ltd 28/01/2020).



Plate 45. Degraded habitat within Cowies Creek (Ecology and Heritage Partners Pty Ltd 28/01/2020).

Table 29. Summary of fish species detected during targeted surveys (Cowies Creek).

Scientific Name	Common Name
Native	
Short-finned Eel	*Anguilla australis*
Australian Smelt	*Retropinna semoni*
Flat-headed Gudgeon	*Philypnodon grandiceps*
Eastern long-necked turtle	*Chelodina longicollis*
Common Yabby	*Cherax destructor*
Introduced	
Mosquito Fish	*Gambusia holbrookii*

Water Quality

Differences in vegetative diversity between pools indicated that salinity varied along the waterway. Accordingly, multiple water quality measurements were taken along the length of the waterway (one reading per pool within the upper and mid reaches of the Creek (Figure 5). Water quality was poor across the waterway, apart from Site 4, with the poorest water quality readings recorded at Site 2 (Figure 5). There was a distinct trend of water quality improving moving downstream with the highest water quality recorded at Site 4 (Figure 5). This was further reflected by the presence of native fish downstream, and a distinct lack of all fish species in the upper reaches.

Site 1: Water quality was poor at site 1 (Table 30). Temperature was as to be expected for this time of year. Dissolved oxygen was high and was likely a reflection of temperature and the abundance of instream and submerged vegetation. Conductivity and salinity was high and is likely a result of previous clearing of trees across the broader landscape which is known to raise the water table drawing salt to the surface, and into surface waters. Higher salinity can be a limiting factor with regard to the presence of less tolerant native fish species. pH was slightly alkaline and turbidity was high. Salt tolerant plants such as Beaded Samphire *Sarcocornia quinqueflora* were present in abundance along the water's edge. This species is often present in brackish Salt marsh environments and is an indicator of a saline environment.

Site 2: Conductivity and salinity were at their highest at Site 2 (Table 30) and was reflected by the absence of fish at this site. It is likely that the previous removal of treed vegetation and intensive farming has influenced the salinity of the waterway over time. Dissolved oxygen was high and was likely a reflection of temperature and the abundance of instream and submerged vegetation. pH was slightly alkaline and turbidity was high.

Site 3: The water quality within Cowies Creek started to improve at Site 3 and is likely a result of steep inclines in the adjacent land features. As a result this area is typically not cropped as intensively as the northern reaches of Cowies creek. Conductivity and salinity are still high (Table 30), however at 7235 microseimen per centimetre conductivity is less than half that recorded at Site 2. The improvement in water quality at Site 3 was reflected by an increase in the abundance and diversity of fish species although species richness at this site should still be considered low. pH was consistent with other sites at 8.62. Turbidity improved when compared to Sites 1 and 2 and was considered moderate.

Site 4: Water quality at Site 4 was vastly improved when compared to all other sites. Conductivity and salinity were significantly lower than recorded at all other sites and waters within this pool can be considered 'fresh'. Temperature and pH were consistent with other sites at 18.8 degrees Celsius and 8.73 respectively. Turbidity was considered moderate. There is no obvious explanation for the improvement in water quality at Site 4. No springs were observed although they may be present below the waterway itself. While a creekline intersected Cowies Creek above this point, it had been dry for an extended period of time. Land use appeared consistent with Site 3. Plant species at Site 4 were reflective of the lower salinity levels with more salt tolerant species such as Beaded Samphire notably absent.

Table 30. Water Quality within Cowies Creek.

Parameter	Measurement			
	Site 1	**Site 2**	**Site 3**	**Site 4**
Temperature (ºC)	18.8	19.6	20.1	18.8
Dissolved Oxygen (%)	90.9	76.9	87.5	66
Dissolved Oxygen (mg.L^{-1})	8.15	6.67	7.76	6.13
Conductivity (µS.cm^{-1})	11055	15405	7235	2539
Salinity (ppt)	7.22	10.15	4.44	1.5
pH	8.61	8.66	8.62	8.73
Turbidity (NTU)	High	High	Moderate	moderate

Ecological Communities

Six nationally listed ecological communities are predicted to occur within 10 kilometres of the NWGGA (DAWE 2021a):

- Grassy Eucalypt Woodland of the Victorian Volcanic Plain;
- Natural Damp Grassland of the Victorian Coastal Plains;
- Natural Temperate Grassland of the Victorian Volcanic Plain;
- Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains;
- Subtropical and Temperate Coastal Saltmarsh; and,
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

Extensive survey was undertaken of all areas where it was considered likely that significant ecological communities could occur, with a particular focus on those areas identified by Ecology and Heritage Partners Pty Ltd 2017a, 2017b) as potentially supporting the relevant community. The previous assessments completed identified the potential for a single nationally listed ecological community to occur, the Natural Temperate Grassland of the Victorian Volcanic Plain.

Remnant River Red-gum patches within the WGGA did not meet the diagnostic characteristics that define the nationally significant *Grassy Eucalypt Woodland of the Victorian Volcanic Plain* given the dominance of non-native grasses in the understorey, lack of community structure and poor native species diversity.

Although the other four nationally listed communities have the potential to occur within the broader locality, the on ground assessment determined them to be absent based on a lack of indicator species, structure, species diversity, and/or falling outside of the community's distribution.

3.2.3 Ecological Communities

3.2.3.1 Natural Temperate Grassland of the Victorian Volcanic Plain

Natural Temperate Grassland of the Victorian Volcanic Plain (NTGVVP) community was recorded at multiple locations within the NGGA (Figure 3), comprising a total of 26.859 hectares (Figure 2).

The Commonwealth condition thresholds for the NTGVVP community (DSEWPaC 2011) were applied to determine the community's presence. Zone PG2 qualified as the threatened ecological community due to meeting or exceeding the following critical criteria:

- Larger than 500 m2;
- Dominated by native grasses; and,
- The dominant native species represent at least 50% of the native species and perennial tussock cover.

Although areas of PG2 recorded on site qualified as the nationally listed community, the relative diversity and structure of the patches only met the minimum conditions of cover and were relatively low in species diversity typically being defined by a combination of Wallaby-grass and Spear-grass and lacking a herb component.

Zones PG1 did not qualify as the listed ecological community as it was dominated by exotic perennial species forming greater than 50% cover, and therefore failed to meet the criteria above.

Based on visual assessments form the roadside, it is likely that additional areas of the NTGVVP community occur in unassessed areas within the NGGA. It is recommended that CoGG further investigate the possibility to gain access to parcels that have not been surveyed to determine the presence of the NTGVVP ecological community.

3.2.3.2 Other Nationally Significant Fauna and Unassessed Areas

It is acknowledged that approximately 33.6% of the NGGA and approximately 13.1% of the WGGA has not been subject to on-ground assessments, and as such, the absence of nationally significant fauna species from these areas cannot be accurately determined. Based on the landscape context, highly modified, agricultural nature of the NWGGA and extent of habitat modification, the likelihood of any additional nationally significant fauna species occurring within the assessed areas of the NWGGA is considered low due to the absence of suitable habitat and lack of records in close proximity (Appendix 2.2).

However, it is recommended that CoGG further investigate the possibility to gain access to parcels that have not been surveyed to determine the presence or not of potential habitat for any nationally significant fauna species. If potential habitat for significant fauna species is observed, then targeted surveys should be undertaken in accordance with the relevant survey guidelines.

3.2.4 Migratory Species

Migratory species listed under the EPBC Act are those protected under international agreements to which Australia is a signatory. These include the Japan Australia Migratory Bird Agreement (JAMBA), the China Australia Migratory Bird Agreement (CAMBA), the Republic of Korea Migratory Bird Agreement (ROKAMBA), and the Bonn Convention on the Conservation of Migratory Species of Wild Animals. Migratory species are considered matters of NES under the EPBC Act.

No species of bird recognised under the migratory provisions of the EPBC Act were recorded during ecological surveys.

While migratory species of bird may occasionally inhabit the broader locality, the NWGGA is not considered to be classed as an 'important habitat' as defined under the *EPBC Act Policy Statement 1.1 Principal Significant Impact Guidelines* (DoE 2013a), in that it does not contain:

- Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species;
- Habitat utilised by a migratory species which is at the limit of the species range; or,
- Habitat within an area where the species is declining.

3.2.5 Ramsar Sites

The nearest Ramsar wetland is the Port Phillip (Western Shoreline) and Bellarine Peninsula, approximately 4.5 kilometres to the east of the NGGA (Figure 1), with the Moorabool River complex ultimately flowing into Lake Connewarre - part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site approximately 14 kilometres to the south-east of the WGGA.

The Port Phillip (Western Shoreline) and Bellarine Peninsula Ramsar site covers 22,650 hectares and comprises six distinct areas that include Point Cook/Cheetham, Werribee/Avalon, Point Wilson/Limeburners Bay, Swan Bay, Mud Islands, and the Lake Connewarre complex.

The NGGA comprises a large part of the Hovells Creek catchment which flows into the Point Wilson/ Limeburners Bay area of the Ramsar site, while the WGGA is located within the Moorabool River catchment, which subsequently feeds into the Barwon River and into the Lake Connewarre Ramsar complex. The Lake Connewarre complex is a saline environment sensitive to increases in freshwater flows.

Therefore, the main potential threat to the Ramsar site from future development of the NWGGA is likely due to potential changes in hydrology (timing, quality and quantity of existing flows) due to changes in surface runoff and stormwater discharge.

Several of the wetlands within the Ramsar site are threatened by stormwater discharges, altering both water regimes and salinity (e.g. Hospital Swamp and Lake Murtnaghurt in the Lake Connewarre Complex). Further investigation is required to determine whether the NWGGA development will result in a significant impact to the Ramsar site, with a summary of recommended further works included in Section 7.2.

3.2.6 Other Matters of NES

The study area does not support any other features corresponding with matters of NES protected under the EPBC Act (i.e. World or National Heritage Areas) (DAWE 2021).

3.3 State Significant Values

Biodiversity matters present within the NWGGA that are considered of significance to the State of Victoria are outlined below.

3.3.1 Flora

The VBA contains records of 68 State-significant flora species within 10 kilometres of the NWGGA (DELWP 2021a) (Appendix 2.2). Most of these species are located outside of the NWGGA in relatively high quality, undisturbed parks and reserves such as Limeburners Lagoon, Hovells Creek Flora and Fauna Reserve, or within road reserves identified along the Princess Highway (Figure 10).

There are previous records within, or within close proximity to the NWGGA including Mugga *Eucalyptus sideroxylon* subsp. *sideroxylon*, Spotted Gum *Corymbia maculata* and Giant Honey-myrtle *Melaleuca armillaris* (Figure 10). However, the NWGGA is well outside the known range of these species, and any records that are present are likely to be planted specimens.

Furthermore, several State significant flora records have not been recorded within the past 50 years, indicating that these species may be locally extinct. The species considered to have the highest likelihood of occurrence within the NWGGA are summarised in Table 31.

Table 31. State significant flora with the highest likelihood of occurrence.

Species	Suitable habitat within the NWGGA	Closet known records
Arching Flax-lily	Throughout	Approximately 10 kilometres east of NGGA.
Austral Tobacco	Throughout	Approximately 7 kilometres north east of NGGA (You Yangs)
Leafless Bluebush	Throughout	Immediately adjacent to the NGGA (north east boundary)
Melbourne Yellow-gum	Within areas of woodland	Approximately 1 kilometre south west of the WGGA
Snowy Mint Bush	Throughout	Approximately 250 metres south west of the WGGA
Straw Wallaby-grass	Throughout	Approximately 1 kilometre south east of NGGA

A single state significant flora species, Leafless Bluebush (listed as 'poorly known on the DELWP Advisory List [DEPI 2014]) was recorded at the north eastern boundary of the NGGA. Individuals were recorded along the road reserve of the Bacchus Marsh Highway.

Although no other state listed species were recorded within the accessible areas of the NWGGA, known records of Melbourne Yellow Gum were confirmed to occur within approximately one kilometre to the south of the WGGA.

Given additional State significant species were not detected through ecological surveys undertaken by Ecology and Heritage Partners within accessible areas (2017a, 2017b), any populations within the assessed areas of the NWGGA that may occur are expected to be very small in numbers and possibly represented by only a few individuals.

It should be noted that the *Flora and Fauna Guarantee Amendment Act 2019* (the Amendment Act) came into effect on June 1, 2020. Under the Amendment Act, species will now be considered for listing as threatened under the FFG Act in accordance with the intergovernmental Common Assessment Method (CAM). This may result in the listing status of several species being revised and may increase the number of State significant species that have the potential to occur within the NWGGA.

However, it should be noted that this report has been prepared based on the current requirements of the FFG Act, and these may change prior to the approval or preparation of any future PSP/NVPPs.

3.3.1.1 Other State Significant Flora and Unassessed Areas

It is acknowledged that approximately 33.6% of the NGGA and approximately 13.1% of the WGGA has not been subject to on-ground assessments, and as such, the absence of State significant flora from these areas cannot be accurately determined. However, it is considered that the likelihood of any remaining State significant species occurring within the assessed areas of the NWGGA is considered low due to the absence of suitable habitats, and/or lack of documented records of these species within close proximity (Appendix 2.2).

It is recommended that CoGG further investigate the possibility to gain access to parcels that have not been surveyed to ascertain the presence/absence of any State significant flora species.

3.3.2 Fauna

The VBA contains records of 42 State-significant fauna species within 10 kilometres of the NWGGA (DELWP 2021a) (Appendix 3.2; Figure 11).

Almost all historical records of state listed fauna species have been observed outside or adjacent to the NWGGA, with notable clusters within Limeburners Lagoon (Hovells Creek) Flora and Fauna Reserve and along the Barwon River (Figure 11).

The species with the highest likelihood of occurrence within the NWGGA are detailed below (Table 32).

Table 32. State significant fauna with highest likelihood of occurrence.

Species	Suitable habitat within the NWGGA	Closet known records
Grey Goshawk	Opportunistic throughout	Immediately south east of the WGGA
Eastern Great Egret	Aquatic habitats	Approximately 1.5 kilometres south east of NGGA
Black Falcon	Opportunistic throughout	Previous records at north eastern boarder of NGGA
Hardhead	Aquatic habitats	Recorded within the NGGA (Ecology and Heritage Partners 2017a)
Tussock Skink	Grassland habitats	Recorded by Ecology and Heritage Partners approximately four kilometres to the south of the WGGA in 2019.

A single state significant fauna species, Hardhead, was observed within the NGGA during the previous study completed by Ecology and Heritage Partners (2017a). The species was observed within a farm dam, which was likely to be acting as sub-optimal habitat for the species due to the lack of fringing vegetation observed within farm dams within this current suite of assessments. As such, it is considered unlikely that such species would maintain a resident population within the habitats present within the NWGGA.

Eastern Great Egret, and Black Falcon are all listed on the Advisory List for Threatened Vertebrate Fauna in Victoria (DSE 2013) and have been recently recorded within close proximity to the NWGGA. It is likely that the avian fauna species would utilise the NWGGA to opportunistically forage, or use as a stepping stone throughout the broader landscape.

An active Platypus burrow was observed within the Moorabool River. While the species was not observed, it is considered to utilise this habitat, and is likely to maintain a resident population within the riparian corridor of the Moorabool River along the western edge of the WGGA.

Although not recorded as part of the Striped Legless Lizard surveys, the NGGA is considered to support suitable habitat for the State significant Tussock Skink, which is known to occur within the broader locality, and has recently (December 2019) been recorded by Ecology and Heritage Partners on multiple occasions within close proximity to the NWGGA. Suitable habitat is considered to occur in areas described as 'confirmed' and 'suitable' habitat for Striped Legless Lizard (Figure 7).

Based on the results of the ecological surveys, habitat assessments and landscape context, the remaining State significant fauna species previously recorded, or considered as having potential habitat within the project locality have been assessed as having a low likelihood of occurrence within the NWGGA (Appendix 3.2). This

determination is based on the modification of potential habitats and the findings of the on-ground assessments.

3.3.3 Vegetation Communities

Field assessments confirmed the presence of one vegetation community listed as threatened under the FFG Act.

3.3.3.1 Western (Basalt) Plains Grassland

Habitat zone PG2 meets the description of the FFG Act-listed vegetation community *Western (Basalt) Plains Grassland*, as well as areas identified as supporting PG1 and embedded rock (DELWP 2021d) (Figure 2).

This community was deemed present in such areas in a 'degraded' state. Although there are no specific condition thresholds that defines the community, its presence was based on two main factors of species diversity and overall cover of native species within any particular area (i.e. areas defined as PG2), and/or the presence of embedded rock and at least 25% cover of native species (i.e. PG1). The inclusion of areas supporting embedded rock as the community recognises the lack of historical impact (e.g. ploughing), and the potential for such areas to re-generate from a seedbank of native species.

The NWGGA supports a total of 132.71 hectares of the *Western (Basalt) Plains Grassland* FFG Act listed community (Figure 2)

3.4 Regionally Significant Features

The VBA contains records of an additional 37 regionally significant fauna species previously recorded within the NWGGA locality (DELWP 2021a) (Appendix 3.2; Figure 11). Of these, two regionally significant species (Spotted Harrier and Eastern Long-necked Turtle) were recorded within the NWGGA during the ecological assessments (Figure 6a; Figure 6b).

The occurrence of the Spotted Harrier was observed flying over grasslands within the NWGGA, while the Long-necked Turtle was captured fyke netting within the western extent of Cowies Creek.

4 LEGISLATIVE AND POLICY IMPLICATIONS

4.1 *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)

The EPBC Act is administered by the Commonwealth Department of Agriculture, Water and the Environment (DAWE) and provides a national framework for the protection of heritage and the environment, and the conservation of biodiversity. The Act establishes a Commonwealth process for the assessment of proposed actions that are likely to have a significant impact on matters of National Environmental Significance (MNES), or on Commonwealth land. An action (i.e. - project, development, undertaking, activity, or series of activities), requires approval from the Commonwealth Environment Minister if it is likely to have a significant impact on any MNES, described in Table 33.

Table 33. Potential impacts to matters of National Environmental Significance (NES)

Matter of NES	Potential Impacts
World Heritage properties	The proposed action will not impact any properties listed for World Heritage.
National heritage places	The proposed action will not impact any places listed for national heritage.
Ramsar wetlands of international significance	The NGGA is located approximately 4.5 kilometres to the west of Limeburners Bay – a part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. The WGGA is bound by the Moorabool River which flows to the Barwon River before reaching Lake Connewarre – a part of the RAMSAR site, approximately 14 kilometres to the south-east. Further investigations to understand the current volume and timing of existing flows into the Ramsar site from the NWGGA must be undertaken to allow the consideration of the potential ecological changes to the character of the Ramsar site that could potentially result from alterations to pre-development flows, and further determine how these changes can be appropriately minimised.
Threatened species and ecological communities	No nationally significant flora species were recorded during targeted surveys. Confirmed presence of three nationally significant fauna species: - Golden Sun Moth; - Growling Grass Frog; and, - Striped Legless Lizard Confirmed presence of one listed ecological community: - NTGVVP (26.865 hectares).
Migratory and marine species	While a number of species may occasionally forage or fly over habitat within the NWGGA, it would not be classed as an 'important habitat' as defined under the EPBC Act Policy Statement 1.1 Principal Significant Impact Guidelines (DoE 2013).
Commonwealth marine area	The proposed action will not impact any Commonwealth marine areas.
Nuclear actions (including uranium mining)	The proposed action is not a nuclear action.
Great Barrier Reef Marine Park	The proposed action will not impact the Great Barrier Reef Marine Park.
Water resources impacted by coal seam gas or mining development	The proposed action is not a coal seam gas or mining development.

4.1.1 Implications For Confirmed Matters Of National Environmental Significance

4.1.1.1 Natural Temperate Grassland of the Victorian Volcanic Plain

A total of 26.865 hectares of the nationally significant ecological community Natural Temperate Grassland of the Victorian Volcanic Plain was recorded within the NGGA.

Potential impacts to the NTGVVP community as a result of future development and an assessment against the significant impact thresholds for the community detailed in DoE (2013) are provided below (Table 34).

Table 34. Significant Impact Guidelines 1.1 – Significant Impact Criteria for Endangered or Critically Endangered Ecological Communities (NTGVVP).

Significant Impact Guidelines 1.1 – Significant Impact Criteria for Endangered or Critically Endangered Ecological Communities (NTGVVP)	
Significant impact Criteria	**Comment**
1. Reduce the extent of an ecological community.	Any impact to NTGVVP should be referred under the EPBC Act.
2. Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines.	Future development of the NGGA has the potential to fragment the ecological community
3. Adversely affect habitat critical to the survival of an ecological community.	Future development of the NGGA has the potential to adversely affect the ecological community
4. Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns.	Future development of the NGGA has the potential to alter surface water drainage patterns
5. Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting.	Disturbance associated with proposed future development may cause a substantial change in the composition of the ecological community
6. Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:	Future development of the NGGA has the potential reduce the quality of the ecological community
a. assisting invasive species, that are harmful to the listed ecological community, to become established or;	
b. causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community.	
7. Interfere with the recovery of an ecological community.	Future development of the NGGA may interfere with the recovery of the ecological community

Based on the above significant impact thresholds, any impact to the NTGVVP ecological community is likely to be considered as a significant impact, and the action should be further assessed under the EPBC Act.

4.1.1.2 Striped Legless Lizard

A total of 45 Striped Legless Lizard were recorded within the NGGA. Based on the extent of contiguous habitat and the location of confirmed records, a total of 103.89 hectares of confirmed habitat is considered present within the NGGA (Figure 7). An additional 83.6 hectares of habitat is suitable (i.e. comprised of native grassland with surface rock present). Although the species was not recorded in these areas, this habitat is still considered suitable, and as per the referral guidelines for the species (DSEWPaC 2011a), if the species is detected during surveys, then all suitable habitat should be considered as occupied. This equates to a total area of suitable Striped Legless Lizard habitat of 187.49 hectares.

A further 207.25 hectares is considered potential habitat (low quality exotic grasslands). However, no Striped Legless Lizard were recorded in these areas (Figure 7). Given the results of targeted surveys, as well as the small home range of the species, there is considered to be a low likelihood that a population of the species is present within areas of low quality potential habitat (Figure 7). Therefore, low quality potential habitat is not assumed to be occupied by a population of Striped Legless Lizard.

Due to the confirmed presence of a viable population within the NGGA that is likely to be a key source population for breeding and /or dispersal, it is considered that this population is an 'important population' as described in the referral guidelines for the species (DSEWPaC 2011a).

Despite systematic surveys for the species within areas of suitable habitat and at an appropriate time of year, no Striped Legless Lizard were recorded within the WGGA.

An assessment of the potential impacts against the significant impact guidelines for the Striped Legless Lizard (DSEWPaC 2011a) is provided below (Table 35).

Table 35. Assessment against the Significant Impact Guidelines for vulnerable species: Striped Legless Lizard (DSEWPaC 2011a; DoE 2013a).

Significant Impact Guidelines 1.1 – Significant Impact Criteria for a Vulnerable Species (Striped Legless Lizard)	
Significant Impact Criteria	**Comment**
1. Disrupt the breeding cycle of an 'important population', defined as: i) key source populations either for breeding or dispersal ii) populations that are necessary for maintaining genetic diversity iii) populations that are near the limit of the species range. iv) Sites more than 0.5 hectares v) Small isolated areas of habitat which are currently under pressure, or are likely to experience long-term pressures (for example sites located within urban settings, such as adjacent to factories or in residential subdivisions)	The NGGA supports an important population of Striped Legless Lizard based on its occurrence within suitable habitat that is greater than 0.5 hectares in size. Given the location and size of the site, this population is not considered to be near the limit of the species range. However, given the NGGA is likely to be subject to future urban development, the action will increase the medium to long-term pressure on the persistence of an important population. Depending on the proposed impacts associated with future development of the NGGA, the action is likely to result in a disruption to the breeding cycle, and place increasing pressure on the persistence and viability of an important population. Any potential impact to Striped Legless Lizards should be referred under the EPBC Act for further assessment.

Significant Impact Guidelines 1.1 – Significant Impact Criteria for a Vulnerable Species (Striped Legless Lizard)	
2. Lead to a long-term decrease in the size of an important population of a species	Depending on the proposed impact to the confirmed habitat mapped for the species, it is possible that the action could lead to a long-term decrease in the size of an important population of the species.
3. Reduce the area of occupancy of an important population	The proposed development of the NGGA has the potential to reduce the area of occupancy of an important population, and/or fragment an existing important population of Striped Legless Lizard.
4. Fragment an existing important population into two or more populations	
5. Adversely affect habitat critical to the survival of a species	Depending on the area of proposed impact, there is a high potential that the proposed action will adversely affect habitat critical to the survival of the species.
6. Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Depending on the area of proposed impact, the proposed action may result in the species to decline within the NGGA.
7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposed action may interfere with the ecological processes or recovery of areas considered to be potential habitat for Striped Legless Lizard.
8. Introduce disease that may cause the species to decline, or	
9. Interfere substantially with the recovery of the species.	

Based on the above significant impact guidelines for vulnerable species, any impact that will adversely affect an important population is likely to constitute a significant impact to Striped Legless Lizard and should be referred under the EPBC Act for further assessment. To mitigate against a potential impact to retained Striped Legless Lizard habitat, a buffer of at least 50 metres should be applied from confirmed (DSEWPaC 2011a).

4.1.1.3 Growling Grass Frog

Targeted surveys identified the species' presence within the WGGA following surveys of both the Moorabool River and Cowies Creek. A population of Growling Grass Frog was identified within Cowies Creek and supported suitable habitat for the species throughout the watercourse within the WGGA. No Growling Grass Frog were recorded along the Moorabool River corridor.

Given the confirmed presence of a viable population within the study area that is not isolated or fragmented from other habitats, it is considered that this population is an 'important population' as described in the significant impact guidelines for the species (DEWHA 2009d).

Potential impacts to Growling Grass Frog as a result of future development and an assessment against the significant impact thresholds for the species detailed in DEWHA (2009d) are provided below (Table 36).

Table 36. Significant impact thresholds for Growling Grass Frog (DEWHA 2009d).

Ecological element affected	Impact Threshold	Comment
Habitat degradation in an area supporting an important population	Permanent removal or degradation of terrestrial habitat within 200 metre of a waterbody in temperate regions that results in the loss of dispersal or overwintering opportunities for an important population.	To mitigate against a potential significant impact to GGF, a 200 metre buffer should be incorporated adjacent to Cowies Creek and Moorabool River.
	Alteration of aquatic vegetation, diversity or structure that leads to a decrease in habitat quality.	If the development negatively impacts the exiting diversity or structure of aquatic habitats, the proposed action may result in a significant impact.
	Alteration to wetland hydrology, diversity and structure.	If the development results in alterations to the existing hydrological regime, the proposed action may result in a significant impact.
	Introduction of predatory fish and/or disease agents.	The proposed action has the potential to result in the introduction of predatory fish/disease agents if not properly managed.
Isolation and fragmentation of populations	Net reduction in the number and/or diversity of waterbodies available to a population.	The proposed action has the potential to reduce the number and/or diversity of waterbodies to the known population
	Removal or alteration of available terrestrial or aquatic habitat corridors.	The proposed action has the potential to remove or alter terrestrial and/or aquatic habitat corridors. To mitigate against a potential significant impact to GGF, a 200 metre buffer should be incorporated adjacent to Cowies Creek and Moorabool River.
	Construction of physical barriers to movement between waterbodies, such as roads or buildings.	The proposed action has the potential to physical barries between suitable habitats. To mitigate against a potential significant impact to GGF, a 200 metre buffer should be incorporated adjacent to Cowies Creek and Moorabool River.

To mitigate against a potential impact to Growling Grass Frog habitats, a suitable buffer (e.g. 200 metres) should be applied from confirmed habitat along each bank of Cowies Creek, as well as potential habitat along the Moorabool River. Frogs are known to use terrestrial areas for foraging, dispersal and overwintering.

Indirect impacts to the quality of the species' habitat caused by alterations to the hydrology of Cowies Creek must also be carefully mitigated. Consideration must be given to any potential drainage strategy for the southern area of the NGGA into Cowies Creek. Increased or decreased flows into confirmed or potential habitat may alter the diversity and structure of riparian vegetation (i.e. fringing and emergent vegetation used for foraging and breeding), change the pH of the water, and decrease water quality through increased

sedimentation and siltation. A summary of mitigation measures that should be considered as part of any future development are summarised in Section 5.3.

If any of the thresholds detailed in Table 36 are exceeded, then the proposed action is likely to result in a significant impact to Growling Grass Frog.

4.1.1.4 Golden Sun Moth

A total of 693.69 hectares of confirmed Golden Sun Moth habitat is present within the NGGA (Figure 9a).

Despite systematic surveys for the species within areas of suitable habitat and at an appropriate time of year, no Golden Sun Moth were recorded within the WGGA (Figure 9b).

An assessment of the potential impacts against the significant impact guidelines for the Golden Sun Moth (DEWHA 2009b) is provided in below (Table 37).

Table 37. Assessment against the Significant Impact Guidelines for Endangered or Critically Endangered Species: Golden Sun Moth *Synemon plana.*

Significant Impact Guidelines policy statement 3.12 – Significant Impact Criteria for the Critically Endangered Golden Sun Moth	
Ecological Element Affected	**Impact Threshold**
Large or contiguous habitat area (> 10 hectares)	Habitat loss, degradation or fragmentation > 0.5 hectares
Small or fragmented habitat area (< 10 hectares)	Any habitat loss, degradation or fragmentation
Habitat connectivity	Fragmentation of a population through the introduction of a barrier to dispersal

Based on the above significant impact guidelines for the species, any impact of 0.5 hectares or greater is likely to constitute a significant impact to Golden Sun Moth.

4.1.1.5 Australian Grayling and Little Galaxias

Targeted surveys for Australian Grayling and Little Galaxias were undertaken in habitat that had the potential to support the species. Despite the efforts of the targeted surveys, no Australian Grayling and Little Galaxias were detected within the NWGGA.

Based on the number of previous records, it is considered that the Australian Grayling are likely to be present within the broader catchment. However, there are several barriers within the Moorabool River at the Batesford Quarry that are likely to prevent the fish accessing habitat further upstream within the WGGA.

It is understood that the Corangamite Catchment Management Authority (CMA) propose to remove these barriers over the next 2-3 years, and once these barriers are removed, and it is likely Australian Grayling will disperse further upstream along the Moorabool River into the WGGA.

The presence of the species within the WGGA is currently considered low. However, regard should be given to the risk and impact to the species associated with potential downstream impacts. Potential downstream impacts and the likely presence of Australian Grayling and Little Galaxias within the Moorabool River once the barriers are removed should be highlighted and considered as part of the future planning of the PSPs within the WGGA, and outline measures to mitigate potential impacts to the species (e.g. sedimentation control, in-stream barrier removal etc).

4.1.2 EPBC Act Assessment Process

The EPBC Act offers two pathways to achieve approval for actions that are likely to have a significant impact on matters of NES. The first of those is the referral (Part 7), assessment (Part 8) and approval process (Part 9 of the EPBC Act). The second is the strategic assessment process (under Part 10 of the EPBC Act). Both processes have their benefits and are appropriate for different situations. A summary of the requirements under each approval pathway is provided below.

4.1.2.1 Part 7, Part 8 and Part 9 Assessment under the EPBC Act (Project by Project Assessment)

Individual actions (often called a 'proposal' or 'project') that are likely to have a significant impact on matters of national environmental significance must be referred to the government for assessment and approval under Part 7 (referral), Part 8 (assessment) and Part 9 (approval) of the EPBC Act. In this instance, a referral via this pathway would be appropriate for an individual landowner within the NGGA or WGGA located in an area that is not covered by the potential Part 10 process.

The referral (Part 7) will be the principal basis for the Minister's decision as to whether approval is necessary and, if so, the type of assessment that is required to be undertaken.

In order to determine whether a referral is required, a proponent should start with the following questions:

- Is the proposed action likely to have a significant impact on a matter of NES? The proponent should undertake a self-assessment against the relevant significant impact thresholds to determine whether a significant impact is likely for a particular matter of NES (See Section 4.1.1);
- Is the proposed action likely to have a significant impact on the environment in general (for actions by Commonwealth agencies or actions on Commonwealth land) or the environment on Commonwealth land (for actions outside Commonwealth land)?

If the answer to either questions is no, approval from the Minister is not required. If the answer to either question is yes, the proponent must submit a referral to the Minster.

In instances where the action is not considered to result in a significant impact to matter of NES, a referral may still be submitted to the Minister to ensure legislative certainty with regards to approvals and legislative implications under the EPBC Act.

Following receipt of a referral, the Minister has 20 business days to decide if the proposed action triggers the matters protected by the EPBC Act and requires further assessment and approval. As part of the 20 business days, the EPBC Act provides a public comment period of 10 business days to provide an opportunity for relevant stakeholders to comment on the proposed action.

During the decision process (including comments from the public) the Minister can make one of three decisions:

1. Not Controlled Action: If the proposed action is not likely to be significant, approval is not required if the action is taken in accordance with the referral. Consequently, the action can proceed (subject to any state, territory or local government requirements);
2. Not Controlled Action - 'Particular Manner': If the proposed action is not likely to be significant if undertaken in a particular manner, approval is not required; and,

3. Controlled Action: If the proposed action is likely to be significant, it is called a 'controlled action'. The matters which the proposed action may have a significant impact on are known as the controlling provisions. Consequently, the proposed action will require approval and is subject to further assessment and approval processes. In most cases, the type of assessment is decided at the same time (decision assessment approach).

Actions can be assessed using one of the following assessment approach:

- Accredited assessment (e.g. Bilateral agreements);
- Assessment on referral information (assessment undertaken solely on the information provided in the referral form);
- Assessment on preliminary documentation (referral form and any other relevant material identified by the minister as being necessary to adequately assess a proposed action). This assessment process is the most commonly used;
- Assessment by environmental impact statement (EIS) or public environment report (PER); or,
- Assessment by public inquiry.

Following the assessment of your proposed action, the Minister will decide whether to:

- Approve the action;
- Approve the action subject to constraints (i.e. conditions will be placed on the action); or,
- Not approve the action.

The Minister will provide a decision to approve with conditions or not to approve the future development of the study area.

4.1.2.2 Part 10 Assessment under the EPBC Act – Strategic Assessment

It is understood that CoGG are seeking to achieve Commonwealth approvals for parts of the NGGA and WGGA via Part 10 of the EPBC Act.

Strategic assessments (Part 10 of the EPBC Act) offer the opportunity to look at, and potentially approve, a series of new proposals or developments (actions) over a landscape/regional scale and timeframe (even if the developer is currently not known).

Strategic assessments are undertaken by the organisation responsible for implementing the Program (for example, state or territory government, local council, industry group or organisation) in partnership with the Australian Government.

The Part 10 strategic assessment process is intended to be a collaborative process that delivers positive outcomes for all relevant parties as it offers the potential to deal with cumulative impacts on matters of NES and look for both conservation and planning outcomes at a much larger scale than can be achieved through project-by-project assessments (as described in Section 4.1.2.1).

The key steps in the strategic assessment process are:

- Preparation of a Strategic Assessment Agreement and terms of reference describing the requirements of the strategic assessment, the geographic coverage of the strategic assessment (where relevant) and the 'classes of actions' to be assessed;
- Public exhibition of the strategic assessment documents;
- Endorsement of the final strategic assessment under Part 10 of the EPBC Act (this means that classes of actions addressed in the strategic assessment will have acceptable impacts on matters of national environmental significance if undertaken in accordance with the endorsed final strategic assessment); and,
- Approval of classes of actions under Part 10 (projects covered by the approval do not need individual referral, assessment or approval under the EPBC Act provided they are undertaken in accordance with the endorsed final strategic assessment).

4.2 Commonwealth Offset Implications

As outlined in the Australian Government's EPBC Act Environmental Offsets Policy (DSEWPaC 2012), a project should be designed to take into consideration the three-step approach, which is:

- Avoid environmental impacts;
- Minimise impacts;
- Where impacts cannot be avoided or minimised, compensate for the residual impacts using other mitigation measures such as offsets; and,
- Ongoing adaptive management:

The EPBC Act Environmental Offsets Policy (DSEWPaC 2012) outlines a framework for the use of environmental offsets under the EPBC Act including when they can be required, how they are determined and the framework under which they operate. Clear guidelines on what constitutes a suitable offset are provided and should be considered as part of any proposed offset strategy. Suitable offsets must include the following:

1. It delivers an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed development.
2. It is built around direct offsets but may include compensatory measures.
3. It is in proportion to the level of statutory protection that applies to the protected manner.
4. It is of a size and scale proportionate to the residual impacts on the protected manner.
5. It is additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs.
6. It effectively accounts for and manages the risks of the offset not succeeding.
7. It is efficient, effective, timely, transparent, scientifically robust and reasonable.
8. It has transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

It should be noted that the actual quantum of offsets generated by an action is highly dependent on the quality of habitats, the proposed management actions and the security mechanism proposed at both the impact site and the proposed offset site.

4.3 *Environment Effects Act 1978* (Victoria)

The *Environment Effects Act 1978* (EE Act) provides for assessments of proposed actions that are capable of having a significant impact on the environment via the preparation of an Environment Effects Statement (EES). A project with potential adverse environmental effects that, individually or in combination, could be significant in a regional or State context should be referred.

4.3.1 Implications

Actions undertaken in accordance with a prescribed PSP are exempt from the requirements of the EE Act. Provided a PSP is prepared guiding future development within the NGGA and WGGA, then a referral under the EE Act is not required.

4.4 *Planning and Environment Act 1987*

The *Planning and Environment Act 1987* outlines the legislative framework for planning in Victoria and for the development and administration of planning schemes. All planning schemes contain native vegetation provisions at Clause 52.17 which require a planning permit from the relevant local Council to remove, destroy or lop native vegetation, unless an exemption applies.

Clause 12. 01 requires planning authorities to consider Protecting Victoria's Environment – Biodiversity 2037 (DELWP 2017c) and the Flora and Fauna Guarantee Strategy under section 17 of the FFG Act when preparing a PSP and associated Native Vegetation Precinct Plan (NVPP).

4.4.1 Native Vegetation Precinct Plan

An NVPP provides for the strategic management of native vegetation for a defined area or precinct. It is established via a planning scheme amendment to incorporate the NVPP and list it in the schedule to Clause 52.16.

An NVPP identifies the native vegetation that can be removed and the vegetation to be protected, based on the conservation significance and land protection role of the vegetation, the identified values of vegetation within the planning scheme such as amenity and landscape, and the broader strategic planning objectives for the precinct (DELWP 2017a). An NVPP must consider the values of native vegetation described in the Guidelines (DELWP 2017b):

- Biodiversity value of native vegetation:
- Extent of native vegetation
- Large trees
- Native vegetation condition
- Ecological Vegetation Class

- Sensitive wetlands and coastal areas
- Strategic biodiversity value
- Habitat for rare or threatened species.
- Other values of native vegetation:
- Land and water protection
- Identified landscape values
- Native vegetation protected under the *Aboriginal Heritage Act 2006*.

4.5 *Flora and Fauna Guarantee Act 1988* (Victoria)

The FFG Act is the primary legislation dealing with biodiversity conservation and sustainable use of native flora and fauna in Victoria. Proponents are required to apply for an FFG Act Permit to 'take' listed and/or protected flora species, listed vegetation communities and listed fish species in areas of public land (i.e. within road reserves, drainage lines and public reserves). An FFG Act permit is generally not required for removal of species or communities on private land, or for the removal of habitat for a listed terrestrial fauna species.

4.6 *Flora and Fauna Guarantee Act Amendment Act 2019* (Victoria)

The *Flora and Fauna Guarantee Amendment Act 2019* (the Amendment Act) came into effect on June 1, 2020. The Amendment Act strengthens the framework for the protection of Victoria's biodiversity, with one of the main amendments now obligating all public authorities to have consideration of biodiversity to ensure decisions and policies are made with proper consideration of the potential impacts on biodiversity.

Further, species will now be considered for listing as threatened under the FFG Act in accordance with the intergovernmental Common Assessment Method (CAM). This may result in the listing status of several species being revised.

However, it should be noted that this report has been prepared based on the current requirements of the FFG Act, and these may change prior to the approval or preparation of any future PSP/NVPPs.

4.6.1 Implications

The VPA, DELWP and CoGG are public authorities under the FFG Act. Public authorities have a duty under the FFG Act to consider potential biodiversity impacts when exercising their functions. The FFG Act listed Platypus, Growling Grass Frog, Striped Legless Lizard and Golden Sun Moth were recorded within the NWGGA. The *Western (Basalt) Plains Grassland* community was recorded within the NGGA. A permit under the FFG Act will be required where impacts to listed FFG Act matters occur on public land. Fifteen species 'protected' under the FFG Act were recorded during the surveys. No flora species considered 'protected' under the FFG Act were recorded during the surveys.

4.7 *Catchment and Land Protection Act 1994* (Victoria)

The *Catchment and Land Protection Act 1994* (CaLP Act) contains provisions relating to catchment planning, land management, noxious weeds and pest animals. Landowners are responsible for the control of any infestation of noxious weeds and pest fauna species to minimise their spread and impact on ecological values.

Weeds listed as noxious under the CaLP Act were recorded during the assessment (Chilean Needle-grass, African Box-thorn, Spear Thistle, Artichoke Thistle, Patterson's Curse, Bathurst Burr, Serrated Tussock and Sweet Briar). Similarly, there is evidence that the NWGGA is currently occupied by several pest fauna species listed under the CaLP Act (Red Fox, European Rabbit and European Hare). Weed management and pest fauna management actions are likely to be required to be incorporated into any future Construction Environmental Management Plan (CEMP) as part of any future development of the NWGGA.

4.8 *Wildlife Act 1975* and Wildlife Regulations 2013 (Victoria)

The *Wildlife Act 1975* (and associated Wildlife Regulations 2013) is the primary legislation in Victoria providing for protection and management of wildlife. Authorisation for habitat removal may be obtained under the *Wildlife Act 1975* through a licence granted under the *Forests Act 1958*, or under any other Act such as the *Planning and Environment Act 1987*.

The purposes of the Wildlife Act are to establish procedures in order to promote:

- The protection and conservation of wildlife;
- The prevention of taxa of wildlife from becoming extinct; and,
- The sustainable use of and access to wildlife.

With the exception of pest animals declared under the CaLP Act or wildlife declared to be unprotected wildlife, the Wildlife Act makes it an offence to hunt, take or destroy protected or threatened wildlife without authorisation.

Any persons engaged to remove, salvage, hold or relocate native fauna during construction must hold a current Management Authorisation under the *Wildlife Act 1975*, issued by DELWP.

5 MITIGATION MEASURES

As outlined in both State and Commonwealth policy, a project should be designed to take into consideration the three-step approach, which is:

- Avoid environmental impacts;
- Minimise impacts; and,
- Where impacts cannot be avoided or minimised, compensate for the residual impacts using other mitigation measures such as offsets.

5.1 Precinct Design Principles

At a broad scale, the following measures should be considered as part of the detailed design process for the future PSPs within the NGGA and WGGA areas:

- Retain areas of high conservation value. High value conservation areas are defined as:
    - Areas supporting confirmed/suitable habitat for matters of NES and associated buffer areas;
    - Patches of native vegetation; and,
    - Large trees and scattered trees.
- Large areas of native vegetation should be protected in habitat nodes;
- Provide a variety of flora and fauna habitats to promote and retain biodiversity;
- Undertake habitat creation (i.e. waterways, drainage lines and designated revegetation areas);
- Provide linear corridors of vegetation along walking/cycling tracks;
- Create linear habitat corridors along waterways/drainage lines/tributaries whilst implementing Water Sensitive Urban Design whilst ensuring no off-site impacts;
- Incorporating drainage lines into habitat corridors and open public spaces;
- Interpret/educate residents about values of grasslands through signage;
- Undertake feral pest animal and plant control;
- Retain native trees in urban active and passive open space areas;
- Feature waterways/landscaping combination of a series of smaller connected basins rather than one large isolated basin.
- Investigate methods to interconnect spaces through Open Space Links to create more complete habitat;
- Rehabilitate and protect significant native vegetation;
- Ensure stormwater treatment is designed to provide habitat(s) for significant flora and fauna species;

- Investigate options to achieve additional canopy coverage on public (open space areas) and private land (residential dwellings, nature strips) to achieve urban greening; and,
- Connect biodiversity sites with parks/open spaces so they are separated from development.

5.2 Best Practice Mitigation Measures

Recommended measures to mitigate impacts upon terrestrial and aquatic values present within the NWGGA may include:

- Control of noxious weeds within the NWGGA should be an immediate priority to reduce further degrading impacts to the existing remnant ecological values present within the NWGGA and surrounds;
- Consideration of Water Sensitive Urban Design techniques such as stormwater treatment wetlands, bio-retention systems, porous paving or swales;
- Minimise impacts to native vegetation and habitats through construction and micro-siting techniques, including fencing retained areas of native vegetation. If indeed necessary, trees should be lopped or trimmed rather than removed. Similarly, soil disturbance and sedimentation within wetlands should be avoided or kept to a minimum, to avoid, or minimise impacts to fauna habitats;
- Tree Retention Zones (TRZs) should be implemented to prevent indirect losses of native vegetation during construction activities (DSE 2011). A TRZ applies to a tree and is a specific area above and below the ground, with a radius 12 x the DBH. At a minimum standard a TRZ should consider the following:
- A TRZ of trees should be a radius no less than two metres or greater than 15 metres;
- Construction, related activities and encroachment (i.e. earthworks such as trenching that disturb the root zone) should be excluded from the TRZ;
- Where encroachment exceeds 10% of the total area of the TRZ, the tree should be considered as lost and offset accordingly;
- Directional drilling may be used for works within the TRZ without being considered encroachment. The directional bore should be at least 600 millimetres deep;
- The above guidelines may be varied if a qualified arborist confirms the works will not significantly damage the tree (including stags / dead trees). In this case the tree would be retained, and no offset would be required; and,
- Where the minimum standard for a TRZ has not been met an offset may be required.
- Ensure that best practice sedimentation and pollution control measures are undertaken at all times, in accordance with Environment Protection Agency guidelines (EPA 1991; EPA 1996; Victorian Stormwater Committee 1999) to prevent offsite impacts to waterways and wetlands; and,
- As indigenous flora provides valuable habitat for indigenous fauna, it is recommended that any landscape plantings that are undertaken as part of the proposed works are conducted using indigenous species sourced from a local provenance, rather than exotic deciduous trees and shrubs.

In addition to these measures, the following documents should be prepared and implemented prior to any construction activities:

- Construction Environmental Management Plan (CEMP). The CEMP should include specific species/vegetation conservation strategies, daily monitoring, sedimentation management, site specific rehabilitation plans, weed and pathogen management measures, etc.;
- A Kangaroo Management Plan (KMP). The KMP provides a long-term, adaptable strategy for the management of Eastern Grey Kangaroos, and may be required to be prepared to the satisfaction of DELWP;
- Growling Grass Frog Conservation Management Plan (GGFCMP). The GGFCMP should detail how aquatic and terrestrial habitat along Cowies Creek will be protected, and enhanced to ensure any potential impacts to the population are mitigated pre, during and post development. The GGFCMP should be prepared in accordance with the principles and have regard to the design guidelines contained in the following documents:
- Growling Grass Frog Habitat Design Standards: Melbourne Strategic Assessment' (DELWP 2017d);
- Growling Grass Frog Masterplan for Melbourne's Growth Corridors (DELWP 2017e); and,
- Growling Grass Frog Crossing Design Standards: Melbourne Strategic Assessment (DELWP 2017f).
- Conservation Management Plan (CMP). One or more CMP's are likely to be required to detail how areas of retained high value biodiversity are protected, managed and enhanced as part of the PSP process. Any conservation area is likely to contain one or more of Golden Sun Moth, Striped Legless Lizard and the NTGVVP ecological community. The CMP should specify management actions and timeframes associated with the protection and enhancement of the retained values. Where more than one matter of NES is present within a conservation area, the management actions proposed must be complementary to all relevant matters.

5.3 Specific Mitigation Measures

5.3.1 Protection of Retained Ecological Values

Retained ecological values should be enhanced and managed to assist in creating a more diverse, connected and resilient natural environment through improving ecosystem health, and develop a more ecologically connected urban landscape. It is important that the enhancement of ecological values within the NWGGA are not undermined through unrestricted and uncontrolled public access throughout retained areas.

Public access should be restricted to clearly defined shared community facilities (i.e. BBQ areas, play equipment etc) that are accessible via a connected network of shared paths (walking and cycling shared paths). Access to all other areas of retained high value native vegetation, revegetated areas and/or wetlands should be discouraged, and demarcated with informal signage and/or fencing where practical.

A summary of practically achievable ecological enhancement opportunities available within areas of retained vegetation and fauna habitat is provided below. It should be noted that the below is not intended to be a detailed plan of the works that should be undertaken, but rather a discussion on the key principals and

management activities that would guide the future restoration of flora and fauna values within the NGGA and WGGA that CoGG could consider as part of the preparation of the future PSPs.

5.3.2 Creation of Conservation Reserves and Biolinks

Three matters of NES are confirmed to occur within the NGGA, with 26.865 hectares of the NTGVVP ecological community, 693.69 hectares of Golden Sun Moth habitat and 187.49 hectares of suitable Striped Legless Lizard habitat (Figure 2; Figure 6a and Figure 7).

The population of Golden Sun Moth is significant in size, with large numbers of the species recorded in the parcels located between Staceys Road and Elcho Road. Any Conservation Reserve established within the NGGA should aim to conserve large areas of confirmed Golden Sun Moth habitat in areas supporting NTGVVP and/or Striped Legless Lizard habitat.

Any conservation reserve established should be as large as possible.

Within WGGA, as no other matters of NES were recorded, the creation of any conservation reserve should focus on areas of confirmed Growling Grass Frog habitat along Cowies Creek and the riparian corridor of the Moorabool River.

A summary of general principles that should be incorporated into the design and location of any conservation reserves are:

- Large reserves are generally preferred over small reserves: Large reserves typically capture and preserve a greater diversity and quality of habitats. In a fragmented landscape, a large reserve can act as core habitat for species and ecosystems. However, the retention of smaller, high quality remnants should not be discounted;
- Connected reserves are better than separated reserves: Connected reserves (via biolinks/habitat corridors) provide flora and fauna populations access to a larger, total area of habitat, maintain genetic diversity and reduce barriers to movement;
- Several reserves are better than one reserve: Populations generally rely on more than one reserve for breeding and/or foraging. The risk of decline of a population due to habitat degradation, improper management or natural causes is greater when there are fewer reserves present within the landscape. The presence of multiple reserve mitigates this risk;
- Exclusion of domestic pets or stock within conservation reserves;
- Implementation of a cat-curfew for residential dwellings adjacent to conservation reserves; and,
- Implementation of non-development buffers around reserves to mitigate against edge effects.

A network of biolinks should be established to link conservation reserves with the aim of supporting biodiversity through:

- Increasing connectivity between areas of ecological value that have previously been isolated/fragmented; and,
- Providing habitat for wildlife that can utilise habitat in narrow corridors for dispersal, foraging, breeding or sheltering;
- Enabling species to disperse to, or recolonise areas where the species was not formerly present.

The width of any biolinks will be dependent on the overall objective of the linkage (i.e. increasing connectivity; providing habitat, bike paths, active open space).

Appropriate biolink / buffer widths to mitigate impacts to relevant matters of NES are:

- To support Striped Legless Lizard, habitat corridors/biolinks, or any buffer around areas of suitable habitat should be a minimum 30 metres in width (DSEWPaC 2011a);
- To reduce impacts to Golden Sun Moth habitat, a buffer of minimum 100 metres and up to 200 metres should be created around conservation reserves to reduce potential impacts during and post construction (DEWHA 2009a); and,
- To mitigate against a potential impact to Growling Grass Frog, a buffer of at least 200 metres (DEWHA 2009d) should be applied from confirmed habitat along each bank of Cowies Creek, as well as potential habitat along the Moorabool River. Frogs are known to use terrestrial areas for foraging and overwintering. Dedicated habitat corridors along potential dispersal routes should be a minimum 100 metres in width (DEWHA 2009d).

Further investigation into the location and width of potential biolinks should be undertaken as part of the PSP/NVPP process. Where a biolink can be created that contains the essential habitat features required to support Golden Sun Moth and/or Striped Legless Lizard, the inclusion of other ancillary uses (i.e. bike paths) should be carefully considered to ensure the long-term viability and objectives from an ecological perspective are not compromised.

A Management Plan must be prepared to ensure the ecological values present within each reserve/biolink are appropriately managed, monitored and enhanced. The management of conservation reserves and biolinks must consider the inclusion of active management activities that result in the desired ecological outcome (i.e. ecological burning), even if this conflicts with the potential use of adjacent land for residential/commercial development. In these instances, the requirement to achieve the conservation management objectives should be prioritised, and not be superseded by adjacent land use preferences.

The design and ongoing management of grassland conservation reserves should have regard to *´Start with the Grasslands: Design guidelines to support native grasslands in urban areas´* (Marshall 2013), which provides best-practice guidance for the design and management of native grasslands to maximise environmental and social outcomes.

5.3.3 Revegetation and Enhancement

The ecological assessment of the vegetation and habitat along the Moorabool River corridor recorded several species of birds and habitat features that are absent within the broader NWGGA.

Through strategic revegetation activities, there is an opportunity to reintroduce some of these habitat features to the treeless riparian corridor along Cowies Creek and increase the carrying capacity of this existing corridor, and over time, result in the re-introduction of suitable habitat for avian and arboreal fauna back into the WGGA (Figure 10b).

In order to ensure any revegetation activities most closely represents the indigenous Creekline Grassy Woodland present along Cowies Creek, it is recommended that the following species list are reviewed (Table 38). However, a high tree canopy cover can reduce the habitat suitability for Growling Grass Frog (DELWP

2017d), so the planting of canopy trees along Cowies Creek must have regard to the habitat preferences and ecology of the species.

Table 38. Species associated with the Creekline Grassy Woodland EVC suitable for revegetation.

Life Form	Species Name	Common Name
T	*Eucalyptus camaldulensis*	River Red-gum
T	*Acacia melanoxylon*	Blackwood
T	*Acacia dealbata*	Silver Wattle
MS	*Melicytus dentatus*	Tree Violet
LTG	*Austrostipa bigeniculata*	Kneed Spear-grass
LTG	*Poa labillardierei*	Common Tussock-grass
MTG	*Rytidosperma caespitosa*	Common Wallaby-grass
MTG	*Lomandra filiformis*	Wattle Mat-rush

Note. T = Tree; MS = Medium Shrub; LTG = Large Tufted Graminoid; MTG = Medium Tufted Graminoid;

It should be noted that the planting densities presented for each life form indicate the recommended density when revegetating for offset purposes. The planting mix and density of plantings should be used as a guideline, and amended according to the proposed use of relevant areas of the parkland proposal (i.e. open active space; passive space etc).

Several patches of Plains Grassland are also present throughout the NWGGA. Many of these patches exhibit a low diversity of native flora, and are homogenous throughout in terms of habitat features and species dominance. In areas of Plains Grassland proposed to be retained, there is an opportunity to enhance these grasslands through the reintroduction a wide variety of (formerly) common grasses and herbs, which in turn, will increase the diversity and structure of the grasslands, and result in an increase in habitat suitability for native fauna. In addition, an opportunity exists to increase the extent of the Plains Grassland by focussing revegetation activities on non-native areas located in between existing, fragmented patches of Plains Grassland. By increasing the extent of Plains Grassland, particularly in potential conservation reserves and/or the buffers created around conservation reserves/biolinks, it is likely that the extent of suitable habitat for a range of native fauna will also increase accordingly.

In order to ensure any revegetation activities most closely represents the indigenous Plains Grasslands, it is recommended that the following species list are reviewed (Table 39).

Table 39. Species associated with the Plains Grassland EVC suitable for revegetation.

Life Form	Species Name	Common Name
SS	*Pimelea curviflora*	Curved Rice-flower
PS	*Atriplex semibaccata*	Berry Saltbush
MH	*Maireana enchylaenoides*	*Wingless Bluebush*
MH	*Calocephalus citroides*	Lemon Beauty-heads
MH	*Acaena echinata*	Sheep's Burr
SH	*Goodenia pinnatifida*	Cut-leaf Goodenia

Life Form	Species Name	Common Name
LTG	*Austrostipa bigeniculata*	Kneed Spear-grass
MTG	*Austrostipa scabra*	Rough Spear-grass
MTG	*Rytidosperma caespitosa*	Common Wallaby-grass
MTG	*Themeda triandra*	Kangaroo-grass

Note. SS = Small Shrub; PS = Prostrate Shrub; MH = Medium Herb; SH = Small Herb; LTG = Large Tufted Graminoid; MTG = Medium Tufted Graminoid.

As part of any best practice revegetation and enhancement strategy, there should also be a focus on planting native grasses, shrubs and/or herbs in areas of public open space.

5.3.4 Habitat Creation

Many species of wildlife rely on natural tree hollows for nesting, breeding and shelter. Hollows provide a safe home away from the weather and predators. In eucalypt trees, small hollows may take over 70 years to develop and large hollows many decades longer. The range of hollow sizes and types is matched by the range of wildlife able to use them.

Nest boxes are an important aspect to wildlife conservation in that they provide additional habitat for hollow-dependant fauna in areas where hollows are in short supply, and in addition, support the persistence or reintroduction of a species in any areas where natural nesting hollows are not available.

The installation of nest boxes of varying types and size will create habitat for arboreal fauna (i.e. possums, birds and microbats).

5.3.5 Riparian Corridor Enhancement

Given the degraded condition of the Cowies Creek corridor, an opportunity exists to embellish the condition of known habitat through revegetation and naturalisation of the vegetation adjacent to the Creekline (Table 38).

Further, within the existing creek corridor, there are opportunities to modify stream banks, introducing minor turbulence within stream, aeration and areas of slower calmer flows. Where possible, modification of stream banks should be located outside of areas supporting patches of native vegetation to avoid and minimise impacts to existing native vegetation as identified in Figure 3. Any changes to the creek, stream bank or riparian vegetation must consider any potential adverse impacts to resident Growling Grass Frog population.

5.3.5.1 Growling Grass Frog

Growling Grass Frog habitat enhancement activities should be undertaken at strategic locations across the WGGA, with a focus on the riparian corridors (and associated buffers) along and adjacent to Cowies Creek and the Moorabool River. Detailed habitat design standards for Growling Grass Frog are outlined in the *Growling Grass Frog Habitat Design Standards: Melbourne Strategic Assessment* (DELWP 2017d) and *Growling Grass Frog Crossing Design Standards: Melbourne Strategic Assessment* (DELWP 2017f). Although the NWGGA is not within the area subjected to the Melbourne Strategic Assessment, these design standards are considered 'best practice' and should be considered when designing future habitats.

Additional mitigation measures should focus on:

- Maintenance of existing hydrological regimes where a population is known to occur;
- Enhancement of habitat quality through:
- Weed removal;
- Planting of native submergent, floating and emergent vegetation;
- Maintenance of some areas of open (unvegetated) water;
- Exotic fish management; and,
- Improvement of terrestrial habitat through the provision of logs, rocks and riparian habitats

The proposed nature of the development means that the areas adjacent to the development footprint may be subject to artificial lighting. Given that the WGGA development boundary is located in close proximity to Cowies Creek and the Moorabool River, any potential impacts associated with light pollution should be appropriately mitigated to ensure there are not negative impacts to the existing Growling Grass Frog populations and other fauna species. A Growling Grass Frog Conservation Management Plan (or similar) should be prepared to ensure that areas of confirmed habitat are retained, managed and enhanced appropriately, and any potential threats appropriately mitigated.

5.3.5.2 Australian Grayling

Based on the number of previous records, it is considered that the Australian Grayling is likely to be present downstream from the WGGA near the junction of the Moorabool and Barwon River (Figure 11). However, there are several barriers within the Moorabool River at the Batesford Quarry that are likely to prevent the species accessing habitat further upstream within the WGGA.

It is understood that the Corangamite CMA propose to remove these barriers over the next 2-3 years, and as such, it is likely Australian Grayling will migrate further upstream along the Moorabool River after the barriers are removed.

Future development of the WGGA and an increase in human activity adjacent to Cowies Creek and the Moorabool River is likely to increase the threats to the Australian Grayling. These threats include the removal or degradation of riparian habitat, increased siltation/sedimentation resulting in a reduction in water quality, alteration in flows, and the potential for additional exotic fish to be released into the catchment due to recreational fishing (Backhouse *et. al*. 2008).

Given the potential presence of Australian Grayling within the Moorabool River catchment, future planning of the PSPs within the WGGA needs to outline measures to avoid impacts (e.g. sedimentation, lower water quality from surrounding developments, in-stream barriers to dispersal) to aquatic values along the waterway.

Further, with the Corangamite CMA proposing to remove the instream barriers near Batesford Quarry, the establishment of a program to monitor the ecological response of the species pre and post development of the WGGA will be an important factor in managing the reintroduction of the species back into this section of the Moorabool River, and ensure the ongoing persistence of the population within the broader catchment.

5.3.5.3 Little Galaxias

Little Galaxias are known to occur within the upper Barwon River catchment near Barwon Downs (DELWP 2020), and have previously been recorded by the Arthur Rylah Institute (ARI) within the Moorabool River near

Batesford, but most likely only reach the Batesford area during a wet spring-summer periods/flows because of the instream barrier at the quarry (Ben Southby – CoGG pers. comm.).

Once the in-stream barriers are removed as proposed by the Corangamite CMA (Section 6.3.6.2), Little Galaxias may populate suitable habitat located within the river corridors adjacent to the WGGA.

In addition to the potential re-introduction of suitable habitat features, the future planning of the PSP's within the WGGA, should take into account measure to mitigate potential impacts to the species (i.e. sedimentation control, in-stream barrier removal etc).

6 SUMMARY OF ECOLOGICAL FEATURES

It is acknowledged that approximately 33.6% of the NGGA and approximately 13.1% of the WGGA has not been subject to on-ground assessments, and several unassessed properties within the NWGGA are likely to support ecological values that have not been observed or recorded as part of this suite of ecological investigations. Based on the quality and extent of known habitats within the NWGGA, particularly, the NGGA, it is highly likely that the extent of suitable habitat as shown on Figure 6a extends beyond areas adequately surveyed during the 2019/20 and 2020/21 survey seasons. In addition, based on visual assessments from roadsides indicating the presence of native vegetation (Figure 2), as well as the presence of modelled extant (2005) native vegetation and Landcover data (DELWP 2021b; Table 15), additional patches of native vegetation are highly likely to be present within these areas (Figure 2; Figure 3).

6.1 Flora

Detailed vegetation mapping completed within the areas assessed on-ground within the NWGGA recorded three EVCs comprising 69.379 hectares of native vegetation within WGGA and 153.647 hectares within NGGA, 102 Large canopy trees and two Large scattered trees within the WGGA and three scattered trees (one Large) within NGGA. A total of 2.259 hectares of 'Current Wetland' as modelled by DELWP is also present within the NGGA study area.

Eighty-four flora species (36 indigenous and 48 non-indigenous or introduced) were recorded within the NWGGA on accessible parcels during the field assessment.

No nationally listed flora species were identified during the targeted surveys across the WGGA and NGGA. However, Adamson's Blown-grass is to be assumed as present based on the presence of suitable habitat (albeit, marginal) within Cowies Creek and relatively recent historical records.

A single state significant flora species (Leafless Bluebush) was recorded at the north eastern boundary of the NGGA.

Although no other state listed species were recorded within the NWGGA, previous records of Melbourne Yellow Gum exist within approximately one kilometre to the south of the WGGA (Figure 10).

6.2 Fauna

Ecological surveys of the NWGGA recorded 75 species of fauna, including 62 native species and 13 introduced species.

A single state significant fauna species, Hardhead has previously been was observed within the NGGA within a farm dam which was likely to be acting as sub-optimal habitat for the species due to the lack of fringing vegetation observed. As such, it is considered unlikely that such species would maintain a resident population within the habitats present within the NWGGA.

Eastern Great Egret, and Black Falcon are all listed on the Advisory List for Threatened Vertebrate Fauna in Victoria (DSE 2013) and have been recently recorded within close proximity to the NWGGA (Figure 11).

An active Platypus burrow was observed within the Moorabool River and is likely to maintain a resident population within the riparian corridor of the Moorabool River along the western edge of the WGGA.

Although not recorded as part of the Striped Legless Lizard surveys, the NGGA is considered to support suitable habitat for the State significant Tussock Skink, which is known to occur within the broader locality. Suitable habitat is considered to occur in areas described as 'confirmed' and 'suitable' habitat for Striped Legless Lizard (Figure 7).

Macquarie Perch and Yarra Pygmy Perch have previously been documented as occurring is directly adjacent to the WGGA and is likely to occur through this section of the Moorabool River.

6.2.1 Striped Legless Lizard

The 2020/21 targeted surveys commenced on 29 September 2021 and were completed on 30 November 2021, with a total of 77 tile grids checked eight times each (a total of 616 tile checks in total).

A total of 45 Striped Legless Lizard were recorded within the NGGA under 10 different tile grids (Plate 33; Plate 34). A total of 12 Striped Legless Lizard were recorded under Grid #54, eight (8) Striped Legless Lizard were recorded under Grids #64 and 52, while Grids #77 and 66 had five and four Striped Legless Lizard respectively (Figure 4a; Figure 6a; Table 21).

Despite targeted surveys being undertaken between September and December at a time when the Striped Legless Lizard was known to be present in the NGGA, no Striped Legless Lizard were recorded in the WGGA.

Sites where the species was recorded generally represent the highest quality habitat for Striped Lizard within the NGGA. These areas support a high cover of surface rock, cracking soils and tussock-forming grasses. The high cover of surface rock at these sites also precludes regular slashing, which maintains a high biomass and dense tussock structure throughout the year.

Based on the location of the confirmed records of the species and quality and extent of habitat, 103.89 hectares of confirmed Striped Legless Lizard habitat is present within the NGGA (Figure 7). An additional 83.6 hectares of suitable habitat (i.e. comprising predominantly native grassland with cracking soils and surface rock) is also present. Although the species was not recorded in these areas, this habitat is considered suitable for the species, and consistent with the referral guidelines for the species (DSEWPaC 2011a), if the species is detected during surveys, then all suitable habitat should be considered occupied. This equates to 187.49 hectares of suitable Striped Legless Lizard habitat.

An additional 207.25 hectares of potential habitat has been mapped (i.e. low quality exotic grasslands, discrete areas of surface rock, highly disturbed). Although this area supports some suitable habitat characteristics, given the results of targeted surveys, together with the small home range of the species, there is considered to be a low likelihood that an extant population of the species are present within areas of low quality potential habitat (Figure 7). Therefore, low quality potential habitat is not assumed to be occupied by Striped Legless Lizard.

6.2.2 Growling Grass Frog

The results of the targeted surveys identified a large population of the nationally listed Growling Grass Frog that occurred throughout Cowies Creek within the WGGA. Individuals were recorded within areas of pooling

water with fringing habitat. Although sections of Cowies Creek were dry, the entire extent of the Creek within the WGGA was considered habitat for the species.

While the Moorabool River corridor could potentially be used by the species opportunistically during dispersal activities, the results of targeted surveys indicate there is a low-moderate likelihood that an extant population of Growling Grass Frog currently occurs along the Moorabool River adjacent to the WGGA.

6.2.3 Golden Sun Moth

The nationally listed Golden Sun Moth was recorded across multiple properties within the NGGA, whereas no individuals were recorded within WGGA. In total, 693.69 hectares of confirmed habitat is present within the NGGA (Figure 6a).

Habitat patches PG2 generally displayed the most suitable habitat for Golden Sun Moth due to the presence of higher quality vegetation and the increased abundance of the species' preferred food plant, Wallaby-grass, in combination with Chilean Needle Grass. Despite the presence of Wallaby-grass in some patches, habitat quality was considered sub-optimal for the species due to the relatively low coverage of preferred native grass species and ground cover generally consisting of less than 10% Wallaby-grass. Further, areas considered as unsuitable habitat showed clear signs of recent disturbance from ploughing, or did not support a high cover of Wallaby-grass or Chilean Needle-grass.

6.2.4 Australian Grayling and Little Galaxias

Targeted surveys for Australian Grayling and Little Galaxias were undertaken in habitat that had the potential to support the species. Despite the efforts of the targeted surveys, no Australian Grayling and Little Galaxias were detected within the WGGA.

Based on the number of previous records, it is considered that the Australian Grayling are likely to be present within the broader catchment area. However, there are several barriers within the Moorabool River at the Batesford Quarry that are likely to prevent the fish accessing habitat further upstream within the WGGA.

It is understood that the Corangamite CMA propose to remove these barriers over the next 2-3 years, and as such, it is possible that the Australian Grayling may populate suitable habitat within the Moorabool River further upstream once the barriers are removed.

6.3 Communities

6.3.1 Natural Temperate Grassland of the Victorian Volcanic Plain

A total of 26.865 hectares of the nationally significant *Natural Temperate Grassland of the Victorian Volcanic Plain* (NTGVVP) ecological community was recorded in habitat zone PG2. This habitat zone also meets the description of the State significant vegetation community *Western (Basalt) Plains Grassland*.

Although areas of PG2 recorded on site qualified as the nationally listed community, the relative diversity and structure of the patches only met the minimum conditions of cover and were relatively low in species diversity typically being defined by a combination of Wallaby-grass and Spear-grass and lacking a herb component.

Zones PG1 did not qualify as the listed ecological community as it was dominated by exotic perennial species forming greater than 50% cover, and therefore failed to meet the criteria.

6.3.2 Western (Basalt) Plains Grassland

Habitat zone PG2 meets the description of the FFG Act-listed vegetation community *Western (Basalt) Plains Grassland*, as well as areas identified as supporting PG1 and embedded rock. A total of 132.71 hectares of the FFG Act community was mapped (Figure 2).

This community was deemed present in such areas in a 'degraded' state. Although there are no specific condition thresholds that defines the community, its presence was based on two main factors of species diversity and overall cover of native species within any particular area (i.e. areas defined as PG2), and/or the presence of embedded rock and at least 25% cover of native species (i.e. PG1). The inclusion of areas supporting embedded rock as the community recognises the lack of historical impact (e.g. ploughing), and the potential for such areas to re-generate from a seedbank of native species.

Table 40. Summary of the ecological values that occur within the assessed areas of the NWGGA.

Species diversity	Moderate assemblage of plants and animals, with 84 flora species and 75 fauna species recorded during the ecological surveys.

Native vegetation	**WGGA**
	• 69.379 hectares of native vegetation represented by three EVCs:
	  ○ *Low Rainfall* Plains Grassland (EVC 132_63) 41.413 hectares;
	  ○ Creekline Grassy Woodland (EVC 68) 4.859 hectares;
	  ○ Floodplain Riparian Woodland (EVC 56) 23.107 hectares;
	• 102 Large Trees in patches;
	• 2 Large Scattered River Red-gum *Eucalyptus camaldulensis*.
	NGGA
	• 155.905 hectares of remnant vegetation represented by one EVC and one DELWP modelled wetland:
	  ○ *Low Rainfall* Plains Grassland (EVC 132_63) 153.647 hectares;
	  ○ Current Wetlands (DELWP) 2.259 hectares.
	• Three Scattered Trees (one Large) Grey Box *Eucalyptus microcarpa.*

Wetlands	• The NGGA site is approximately 4.5 kilometres west of Limeburners Bay – a part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site. • The Moorabool River system (western boundary of the WGGA) flows into Lake Connewarre - part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site.
Significant ecological communities	• A total of 26.859 hectares of the nationally significant ecological community *Natural Temperate Grassland of the Victorian Volcanic Plain* is present in the study area; • A total of 132.71 hectares of the *Western (Basalt) Plains Grassland Community* is present in the study area (Figure 2).

Significant flora species	• No nationally significant flora were recorded in the study area.
	  ○ Assumed presence of Adamson's Blown-grass *Lachnagrostis adamsonii* within suitable habitat adjacent to Cowies Creek in the WGGA.
	• One State significant flora was recorded within the study area:
	  ○ Leafless Bluebush *Maireana aphylla*

Significant fauna species	• Known presence of three nationally significant fauna:

	○ Confirmed presence of an important population of Growling Grass Frog along the Cowies Creek corridor; ○ 187.49 hectares of suitable habitat for Striped Legless Lizard within the NGGA; ○ 693.69 hectares of confirmed habitat for Golden Sun Moth within the NGGA. • Known presence of one State significant fauna: ○ Platypus *Ornithorhynchus anatinus.* • Known presence of two Regionally significant fauna: ○ Eastern Long-necked Turtle *Chelodina longicollis;* ○ Spotted Harrier *Circus assimilis.*

7 RECOMMENDATIONS

7.1 Unassessed Areas

Access was not permitted in several parcels within the NWGGA, with approximately 33.6% and 13.1% of the overall land within the NGGA and WGGA respectively unable to be assessed on-ground (Figure 2; Figure 3).

However, based on the quality and extent of known habitats within the NWGGA, particularly, the NGGA, it is highly likely that the extent of suitable habitat as shown on Figure 6a extends beyond areas adequately surveyed during the 2019/2020and 2020/2021 survey seasons. In addition, based on visual assessments from roadsides indicating the presence of native vegetation (Figure 2), as well as the presence of modelled extant (2005) native vegetation (DELWP 2021a; Table 15), it is highly likely that additional patches of native vegetation are present within these areas (Figure 2; Figure 3).

Although the majority of parcels that were not surveyed comprise rural residential dwellings that are likely subject to regular disturbance (i.e. mowing), these parcels may still support ecological values consistent with those already confirmed within the NWGGA.

It is recommended that CoGG further investigate the possibility to gain access to parcels that have not been surveyed to enable the quality and extent of native vegetation to be confirmed, determine the presence of any significant ecological communities, as well as to identify the presence of potential habitats for Spiny Rice-flower, Golden Sun Moth and Striped Legless Lizard.

If potential habitat for significant flora or fauna is observed, then targeted surveys should be undertaken in accordance with the relevant survey guidelines.

7.2 Port Phillip (Western Shoreline) and Bellarine Peninsula Ramsar Site

Several of the wetlands within the Ramsar site are threatened by stormwater discharges, altering both water regimes and salinity (e.g. Hospital Swamp and Lake Murtnaghurt in the Lake Connewarre Complex).

With only the current ecological information for the NWGGA, it is not possible to determine whether the proposed action will result in a significant impact to the Ramsar site. It is recommended that COGG engage a stormwater engineer (or similar) to undertake modelling of the potential stormwater impacts to Limeburners Bay, Hovells Creek and the Moorabool River catchments and the associated downstream flows into the Ramsar site. In particular, the Lake Connewarre complex is a saline environment sensitive to increases in freshwater flows. In turn, the saline environment creates foraging habitat for Swift Parrot, which is at risk of being compromised if the ecological character of the Ramsar site is altered.

An integrated Water Management (IWM) approach should be considered, and provides an opportunity to manage all components of the water cycle including:

- Waterways and bays;
- Wastewater management;
- Alternative and potable water supply;

- Stormwater management; and,
- Water treatment.

An IWM approach was used for the Anchoridge Development in Armstrong Creek which resulted in a reduction of the impacts from excessive freshwater discharge to the saline Ramsar site, and ensured important habitat for the Growling Grass Frog and Swift Parrot *Lathamus discolor* was maintained and enhanced.

Further investigations to understand the current volume and timing of existing flows into the Ramsar site from the NWGGA must be undertaken to allow the consideration of the potential ecological changes to the character of the Ramsar site that could potentially result from alterations to pre-development flows, and further determine how these changes can be appropriately minimised.

In addition, the investigation should also include an assessment of potential changes to water quality from flows into the Ramsar site, including changes potentially affected by:

- Sedimentation from construction activities; and,
- Fuel, oil and other toxicants – both during construction and ongoing.

Impacts to water quality can be partially mitigated by ensuring management practices and construction techniques are consistent with *Construction Techniques for Sediment Pollution Control* (EPA 1991) and *Environmental Guidelines for Major Construction Sites* (EPA 1996).

The drainage and stormwater strategy prepared for the NWGGA must have regard to the known values and potential impacts relevant to the Ramsar site and be developed in a manner that seeks to minimise and mitigate potential adverse effects to the ecological values present.

7.3 Current Wetlands

Current Wetlands are classified as native vegetation in accordance with Victoria's native vegetation policy 'The Guidelines' (DELWP 2017a), and as such, the extent of Current Wetlands within the NWGGA must be included within overall extent of native vegetation impacts if impacted via development.

However, it is possible to submit an application to DELWP to amend, exclude or modify a mapped wetland from assessment. The Native Vegetation Regulation (NVR) Team at DELWP published an updated method to exclude/modify a mapped wetland in their November 2019 newsletter (DELWP 2019b). This method focuses on wetlands associated native vegetation, rather than the full range of wetland values, and replaces the method described in Appendix 4, Section D2 of the '*Assessors Handbook: Applications to remove, destroy or lop native vegetation*' (DELWP 2018).

A summary of the requirements of this method is provided in Table 41.

Table 41. Method to exclude a mapped wetland shown in the Current wetlands map from the assessment process

Mapped wetland (or part thereof) may be excluded from the assessment process if:	Evidence required from the applicant	Approval Authority
Mapped wetland cannot support native vegetation. - Part or all of the mapped wetland cannot support native vegetation. - Impacts from illegal actions that may have destroyed the wetland will not be considered	Aerial photography, on-ground photographs, hydrological assessment, description of vegetation present.	Written agreement from Secretary to DELWP.
	The hydrological assessment must: • explain why wetland-associated native vegetation cannot grow in the mapped wetland. For example: Has the water source been cut off? Is the water level too deep, too turbid or too salty? Do existing approved land uses prevent wetland-associated native vegetation growth? • be completed by a suitably qualified person with experience in assessing the values of waterbodies and wetlands. A description of that experience must be included with assessment.	

It is recommended that an Index of Wetland Condition (IWC) Assessment is undertaken at any Current Wetlands within the NWGGA to determine whether it is feasible to exclude or modify a Current Wetland from further assessment as part of the assessment process under the Guidelines (DELWP 2017a).

REFERENCES

Ashworth, J.M. 1998. An appraisal of the conservation status of Litoria raniformis (Kefferstein) in Tasmania. M.Env.Sci. Thesis, University of Tasmania, Hobart.

Aulsebrook A.E., Jones T.M., R.A. Mulder and Lesku J.A. 2018. Impacts of artificial light at night on sleep: a review and prospectus Journal of Experimental Zoology Part A. 329 (8-9) 409-41

Backhouse, G., Jackson, J., and O'Connor, J. (2008). National Recovery Plan for the Australian Grayling *Prototroctes maraena*. Melbourne: Department of Sustainability & Environment.

Barker, J., Grigg, G.C. and M.J. Tyler 1995. A field guide to Australian frogs. Surrey Beatty and Sons, Chipping Norton.

Belcher, R.O. 1983. New Australian species of Erechthitoid Senecio (Asteraceae). Muelleria. 5(2):119-122.

Carter, O. 2010. *National Recovery Plan for the Matted Flax-lily Dianella amoena*. Department of Sustainability and Environment, Victoria.

Christidis, L. and Boles, W.E 2008. *Systematics and Taxonomy of Australian Birds*. CSIRO Publishing, Collingwood, Victoria.

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.

COGG 2020. *The City of Greater Geelong Norther and Western Geelong Growth Areas Framework Plan – August 2020*. Prepared by the City of Greater Geelong (CoGG).

Cogger, H. G (Ed). 1996. Reptiles and Amphibians of Australia. 5th Edition. Reed Books Australia, Victoria.

Cogger, H. G., Cameron, E. E. and Cogger, H. M. 1983. Volume 1 of Zoological Catalogue of Australia: Amphibia and Reptilia. Australian Government Publishing Service, Canberra.

Cogger, H.G., Cameron, E.E., Sadlier, R.A. and Eggler P., 1993. The Action Plan for Australian Reptiles. Australian Nature conservation Agency, Canberra, ACT

Coulson, G. 1990. Conservation Biology of the Striped Legless Lizard (*Delma impar*): an initial investigation. Arthur Rylah Institute for Environmental Research Technical Report Series No. 106, Department of Conservation and Environment, Melbourne.

Coulson, G. 1995. Management directions for the Striped Legless Lizard (Delma impar) in the Australian Capital Territory. Technical Report 12. Wildlife Research Unit, ACT Parks & Conservation Service.

Cowx, I.G. and Lamarque, P. 1990. Fishing with Electricity; applications in freshwater fisheries management. (Fishing News Books, Oxford, United Kingdom).

Cropper, S. 1993. Management of Endangered Plants. CSIRO Publications, East Melbourne, Victoria

DAWE 2021a . Senecio macrocarpus in Species Profile and Threats Database, Department of Agriculture, Water and the Environment, Canberra. Available from: http://www.environment.gov.au/sprat.

DAWE 2021b. Glycine latrobeana in Species Profile and Threats Database, Department of Agriculture, Water and the Environment, Canberra. Available from: http://www.environment.gov.au/sprat.

DAWE 2021c. Rutidosis leptorhynchoides in Species Profile and Threats Database, Department of Agriculture, Water and the Environment, Canberra. Available from: http://www.environment.gov.au/sprat

DAWE 2021d. SPRAT Profile: *Dianella amoena* — Matted Flax-lily [WWW Document]. URL https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=64886. Department of Agriculture, Water and the Environment, Canberra. (WWW Document)

DAWE 2021e. Galaxiella pusilla in Species Profile and Threats Database, Department of Agriculture, Water and the Environment, Canberra. Available from: http://www.environment.gov.au/sprat.

DAWE 2021f. Lachnagrostis adamsonii in Species Profile and Threats Database, Department of Agriculture, Water and the Environment, Canberra. Available from: http://www.environment.gov.au/sprat

DELWP 2017a. *Preparing a Native Vegetation Precinct Plan.* Victorian Department of Environment, Land, Water and Planning, Melbourne, Victoria.

DELWP 2017b. *Guidelines for the removal, destruction or lopping of native vegetation*. Victorian Department of Environment, Land, Water and Planning, Melbourne, Victoria.

DELWP 2017c. *Protecting Victoria's Environment – Biodiversity 2037.* Victorian Department of Environment, Land, Water and Planning, Melbourne, Victoria.

DELWP 2017d. *Growling Grass Frog Habitat Design Standards: Melbourne Strategic Assessment.* Victorian Department of Environment, Land, Water and Planning, Melbourne, Victoria.

DELWP 2017e. *Growling Grass Frog Masterplan for Melbourne's Growth Corridors*. Victorian Department of Environment, Land, Water and Planning, Melbourne, Victoria.

DELWP 2017f. *Growling Grass Frog Crossing Design Standards: Melbourne Strategic Assessment.* Victorian Department of Environment, Land, Water and Planning, Melbourne, Victoria.

DELWP 2018. Assessor's handbook. Applications to remove, destroy or lop native vegetation. Version 1.1. The State of Victoria Department of Environment, Land, Water and Planning. Melbourne, October 2018.

DELWP 2019a. *Flora and Fauna Guarantee Act 1988* Protected Flora List – November 2019. Victorian Department of Environment, Land, Water and Planning. Melbourne, Victoria.

DELWP 2019b. The Native Vegetation Newsletter – November 2019. Victorian Department of Environment, Land, Water and Planning, Melbourne, Victoria.

DELWP 2021a. Victorian Biodiversity Atlas. Sourced from GIS layers: "VBA_FLORA25", "VBA_FLORA100", "VBA_FAUNA25", "VBA_FAUNA100". Victorian Department of Environment, Land, Water and Planning, Melbourne, Victoria.

DELWP 2021b. NatureKit [www Document]. URL: <https://www.environment.vic.gov.au/>. Victorian Department of Environment, Land, Water and Planning, Melbourne, Victoria.

DELWP 2021c. Ecological Vegetation Class (EVC) Benchmarks for each Bioregion [www Document]. URL: <http://www.depi.vic.gov.au/environment-and-wildlife/biodiversity/evc-benchmarks#bioregionname>. Victorian Department of Environment, Land, Water and Planning, Melbourne, Victoria.

DELWP 2021d. *Flora and Fauna Guarantee Act 1988* – Threatened List: Characteristics of Threatened Communities [WWW Document]. URL: <http://www.depi.vic.gov.au/environment-and-

wildlife/threatened-species-and-communities/flora-and-fauna-guarantee-act-1988/scientific-advisory-committee/victorian-threatened-community-descriptions>.

DELWP 2021e. Planning Maps Online [www Document]. URL: <http://services.land.vic.gov.au/maps/pmo.jsp>. Victorian Department of Environment, Land, Water and Planning, Melbourne, Victoria.

DELWP 2021f. *Flora and Fauna Guarantee Act 1988* Threatened List – January 2021. Victorian Department of Environment, Land, Water and Planning, Melbourne, Victoria.

DEPI 2013. Sub-regional species strategy for the Growling Grass Frog. Published Victorian Government. Department of Environment and Primary Industries, Melbourne, May 2013.

DEWHA 2009a. Significant impact guidelines for the critically endangered spiny rice-flower (*Pimelea spinescens* subsp. *spinescens.* Nationally threatened species and ecological communities. EPBC Act policy statement 3.11.

DEWHA 2009b. Significant Impact Guidelines for the Critically Endangered Golden Sun Moth (*Synemon plana*). Department of the Environment, Water, Heritage and the Arts, Canberra.

DEWHA 2009c. 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*)

DEWHA 2009d. Significant impact guidelines for the vulnerable growling grass frog (*Litoria raniformis*. Nationally threatened species and ecological communities EPBC Act policy statement 3.14. Department of Environment, Water, Heritage and the Arts. Commonwealth of Australia, Canberra.

DEWHA 2009e. Significant impact guidelines for the vulnerable growling grass frog (*Litoria raniformis*).

DEWHA 2010. Survey Guidelines for Australia's Threatened Frogs. Department of Environment, Water, Heritage and the Arts. Canberra, ACT.

DEWHA 2020a. Protected Matters Search Tool. Commonwealth Department of Environment and Energy, Canberra, ACT.

DEWHA 2020a. Protected Matters Search Tool. Commonwealth Department of Environment and Energy, Canberra, ACT.

DoE 2013a. Significant Impact Guidelines 1.1. Matters of National Environmental Significance. Commonwealth Department of the Environment, Canberra, ACT.

DoE 2013b. Survey Guidelines for Australia's Threatened Orchids. Guidelines for Detecting Orchids Listed as 'Threatened' Under the Environment Protection and Biodiversity Conservation Act 1999

Dorrough, J. 1995. Past and present habitat of the Striped Legless Lizard, *Delma impar* (Pygopodidae), in the Australian Capital Territory. An unpublished report to the Wildlife Research Unit, ACT Parks and Conservation Service.

DSE 1992. Flora and Fauna Guarantee Action Statement #28. Button Wrinklewort *Rutidosis leptorrynchoides*. Department of Sustainability and Environment, Melbourne, Victoria.

DSE 1992. Flora and Fauna Guarantee Action Statement #28. Button Wrinklewort *Rutidosis leptorrynchoides*. Department of Sustainability and Environment, Melbourne, Victoria.

DSE 2004. Vegetation quality assessment manual: Guidelines for applying the habitat hectares scoring method. Version 1.3. Victorian Department of Sustainability and Environment, Melbourne Victoria

DSE 2004. Vegetation quality assessment manual: Guidelines for applying the habitat hectares scoring method. Version 1.3. Victorian Department of Sustainability and Environment, Melbourne Victoria

DSE 2010. Biodiversity Precinct Structure Planning Kit. Victorian Department of Sustainability and Environment, Melbourne Victoria

DSE 2012. National Recovery Plan for the Southern Bell Frog *Litoria raniformis*. Prepared by Nick Clemann and Graeme R. Gillespie. Published by the Victorian Government Department of Sustainability and Environment, Melbourne, January 2012.

DSEWPaC 2011a. Environment Protection and Biodiversity Conservation Act 1999: referral guidelines for the vulnerable striped legless lizard, Delma impar. Commonwealth Department of Sustainability, Environment, Water, Population and Communities. Canberra, ACT.

DSEWPaC 2011b. Survey Guidelines for Australia's threatened reptiles. Guidelines for detecting reptiles listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999.

DSEWPaC 2011c. Nationally Threatened Ecological Communities of the Victorian Volcanic Plain: Natural Temperate Grassland and Grassy Eucalypt Woodland A guide to the identification, assessment and management of nationally threatened ecological communities Environment Protection and Biodiversity Conservation Act 1999.

DSEWPaC 2011d. Survey guidelines for Australia's threatened fish: Guidelines for detecting fish listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999. The Commonwealth Department of Sustainability, Environment, Water, Population and Communities. Canberra, ACT.

Duncan, A., Baker, G.B. and Montgomery, N. (Eds) 1999. The Action Plan for Australian Bats. Environment Australia. Canberra, ACT.

Durrant J., Botha L.M., Green M.P. and Jones T.M. 2018. Artificial light at night prolongs juvenile development time in the cricket *Teleogryllus commodus*. Journal of Experimental Zoology Part B. 330 (4)225-233

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

Faragher, R.A. and Rodgers, M. 1997. Performance of sampling-gear types in the New South Wales River Survey. In: 'Fish and Rivers in Stress - The NSW Rivers Survey' (Eds. J.H. Harris & P.C. Gehrke) pp. 251-258 (Fisheries Office of Conservation and the Cooperative Research Centre for Freshwater Ecology)

Garnett, S.T. and Crowley, G. M. 2000. *The Action Plan for Australian Birds 2000*. Environment Australia.

Gullan, P 2017. Illustrated Flora Information System of Victoria (IFLISV). Viridans Pty Ltd, Victoria.

Hadden, S. 1995. Distribution, Status and Habitat Requirements of the Striped Legless Lizard *Delma impar* (Fischer). Final Report to the Australian Nature Conservation Agency. Department of Conservation and Natural Resources, Melbourne.

Hamer, A., and Organ, A. 2008. Aspects of the ecology and conservation of the Growling Grass Frog Litoria raniformis in an urban-fringe environment, southern Victoria. Australian Zoologist: 2008, Vol. 34, No. 3, pp. 393-407.

Heard, G.W., Scroggie, M.P., and Clemann, N. 2010. Guidelines for managing the endangered Growling Grass Frog in urbanising landscapes. Arthur Rylah Institute for Environmental Research Technical Report Series No. 208. Department of Sustainability and Environment, Heidelberg, Victoria

Hero J, Littlejohn M and Marantelli G. 1991. Frogwatch Field Guide to Victorian Frogs. Department of Conservation and Environment: Victoria.

Kukolic, K. 1991. Report on the vertebrate fauna surveys at Gungahlin. pp. 12–19 in The ACT's Native Grasslands. Conservation Council of the South-East Region and Canberra, Canberra.

Kukolic, K. and Osborne, W.S. 1993. Striped Legless Lizard (*Delma impar*). pp. 17–21 in, Sharp, S. (ed.). Lowland Native Grasslands in the Australian Capital Territory: Survey of sites and assessment of the conservation status, habitat and management requirements for species of concern. ACT Parks and Conservation Service, Conservation Series Report 6/93.

Lee, A. K. 1995. *Action Plan for Australian Rodents*. Australian Nature Conservation Agency, Canberra.

Longcore, T. and Rich, C. 2004. 'Ecological Light Pollution', Frontiers in Ecology and the Environment, vol. 2, no. 4, pp. 191-8.

Marshall, A. 2013. *Start with the Grasslands: Design guidelines to support native grasslands in urban areas.* Melbourne. Victorian National Parks Association.

Maxwell, S., Burbidge, A.A. and Morris, K (Eds) 1996. *The 1996 Action Plan for Australian Marsupials and Monotremes*. Wildlife Australia for Australasian Marsupial and Monotreme Specialist Group and the IUCN Species Survival commission, Switzerland.

Morgan J.W. 1995. Ecological Studies of the Endangered Rutidosis leptorrhynchoides. I. Seed Production, Soil Seed Bank Dynamics, Population Density and their Effects on Recruitment, Aust. J. Bot., 1995,43,l-11.

Murphy, A. 2010. National Recovery Plan for Adamson's Blown Grass *Lachnagrostis adamsonii*. Department of Sustainability and Environment, Melbourne.

Nelson, J. S. 1994. *Fishes of the World, 3rd Edition*. John Wiley & Sons, New York.

NSW Office of Environment and Heritage 2012. National Recovery Plan for Button Wrinklewort Rutidosis leptorrhynchoides. NSW Office of Environment and Heritage, Hurstville

O'Shea M. B. (2005) Methods for assessment and techniques for management of striped legless lizard *Delma impar* populations in south-eastern Australia. In: *Sustainability Group* pp. 237. Victoria University of Technology, Melbourne.

OEH 2012. National Recovery Plan for Button Wrinklewort *Rutidosis leptorrynchoides. Prepared by the New South Wales Office of Environment and Heritage. Queanbeyan, NSW.*

Organ, A. 2003. Growling Grass Frog *Litoria raniformis* monitoring over the 2002/03 breeding period, Western Treatment Plant, Werribee, Victoria. Biosis Research Pty. Ltd. unpublished report for Melbourne Water Corporation.

Organ, A. 2004. Pakenham Bypass: Growling Grass Frog *Litoria raniformis* 2003/04 survey, Pakenham and surrounds Victoria. Biosis Research Pty. Ltd. unpublished report for VicRoads.

Organ, A. 2005. Pakenham Bypass: Conservation Management Plan for the Growling Grass Frog *Litoria raniformis*, Pakenham, Victoria. Biosis Research Pty. Ltd. unpublished report for VicRoads.

Pidgeon, R 2004. A review of options for monitoring freshwater fish biodiversity in the Darwin Harbour catchment. Report prepared for Water Monitoring Branch, Natural Resource Management Division, Department of Infrastructure, Planning & Environment, January 2004.

Robertson P. & Smith W. (2010) National recovery plan for the striped legless lizard (Delma impar). Department of Sustainability and Environment, Melbourne.

Robertson, P and Evans, M. 2012. National Recovery Plan for the Grassland Earless Dragon *Tympanocryptis pinguicolla*. As varied in October 2012. ACT Department of Territory and Municipal Services, Canberra.

Robertson, P., Heard, G. and Scroggie, M. 2002. The ecology and conservation status of the Growling Grass Frog (Litoria raniformis) within the Merri Creek corridor. Interim report: distribution, abundance and habitat requirements. Wildlife Profiles Pty Ltd/Arthur Rylah Institute for Environmental Research for DNRE, Flora and Fauna Branch.

Rohr, D.H. and Peterson, G.N.L. 2003. The Striped Legless Lizard in the Western District of Victoria: New Insights. Technical Report to the Glenelg Hopkins Catchment Management Authority. Ecology Research Group: RMIT University, Melbourne.

Saddlier, S., Jackson, J. and Hammer, M. 2008. *National Recovery Plan for the Dwarf Galaxias Galaxiella pusilla*. Department of Sustainability and Environment, Melbourne.

Sands, D.P.A. and New, T.R. 2002. *The Action Plan for Australian Butterflies*, Environment Australia, Canberra

Scroggie, M. P., Peterson, G.N. L., Rohr, D. H., Nicholson, E., and Heard, G. W. 2019. *Disturbance has benefits as well as costs for fragmented populations of a cryptic grassland reptile*. Landscape Ecology. 34: 1949-1965.

SEWPaC 2011a. Survey guidelines for Australia's threatened reptiles: Guidelines for detecting reptiles listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999. Commonwealth Department of Sustainability, Environment, Water, Population and Communities. Canberra, ACT.

Smith, W.J.S. and Robertson, P. 1999. National recovery plan for the Striped Legless Lizard (*Delma impar*) 1999-2003. Unpublished report to Environment Australia, Canberra.

TSSC 2008. Advice to the Minister for the Environment, Heritage and the Arts from the Threatened Species Scientific Committee (TSSC) (the Committee) on an amendment to the list of threatened ecological communities under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Natural Temperate Grassland of the Victorian Volcanic Plain. Departments for the Environment, Heritage and the Arts. Canberra

TSSC 2012. Advice to the Minister for Sustainability, Environment, Water, Population and Communities from the Threatened Species Scientific Committee (TSSC) (the Committee) on an amendment to the list of threatened ecological communities under the *Environment Protection and Biodiversity Conservation Act*

1999 (EPBC Act). Seasonal Herbaceous Wetlands (Freshwater) of Temperate Lowland Plains. Department for Sustainability, Environment, Water, Population and Communities. Canberra.

Tyler, M.J. 1997. *The Action Plan for Australian Frogs*. Wildlife Australia: Canberra.

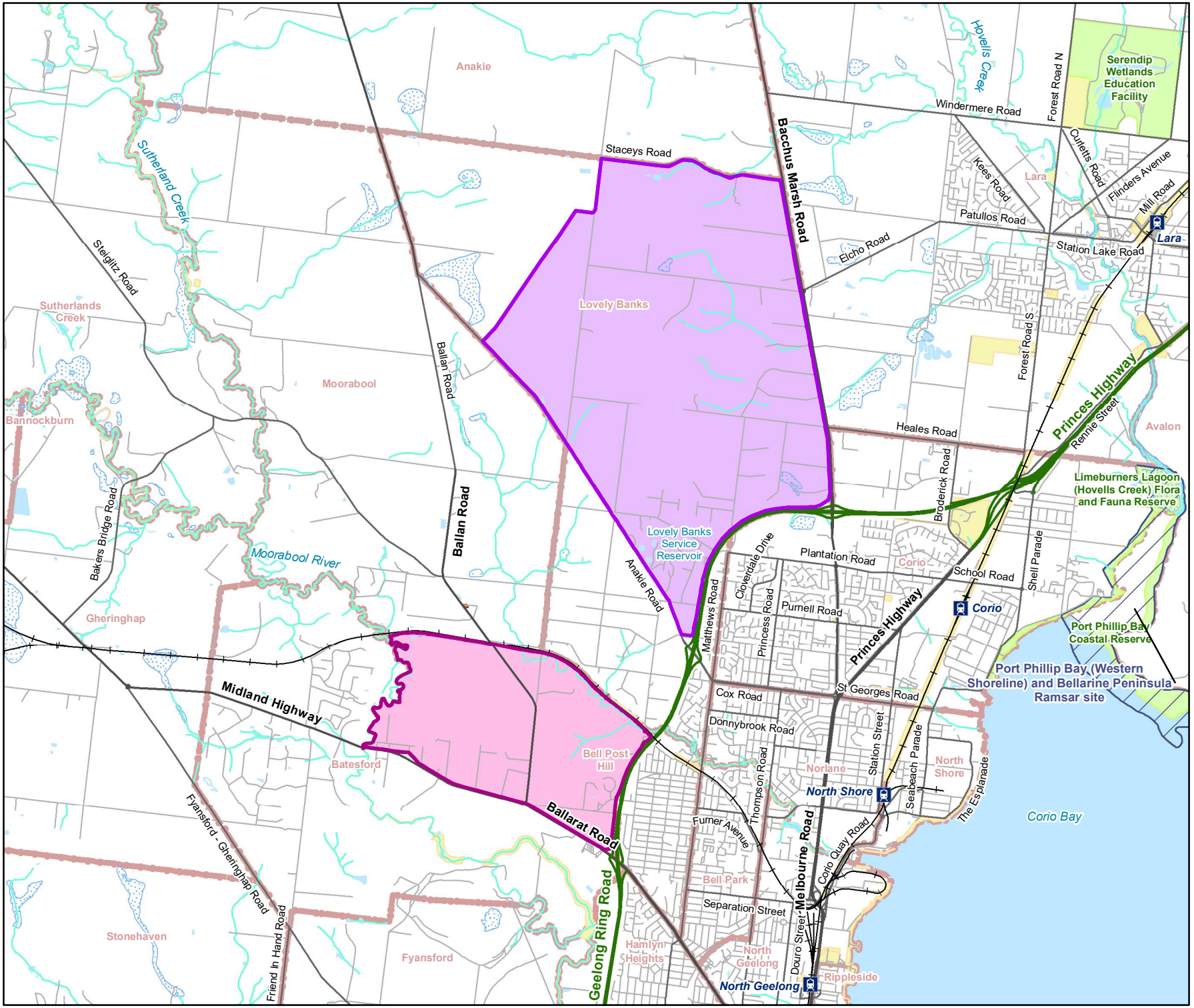
Wassens, S., Watts, R.J., Jansen, A. and Roshier, D. 2008. Movement patterns of southern bell frogs (Litoria raniformis) in response to flooding. Wildlife Research 35: 50–58.

Webster, A., Fallu, R. and Preece, K. 2003. Flora and Fauna Guarantee Action Statement No. 17. Striped Legless Lizard *Delma impar* (updated website edition). Department of Conservation & Environment, Victoria.

Willmott NJ, Henneken J, Elgar MA, and Jones TM. 2019. Guiding lights: foraging responses of juvenile nocturnal orb-weavers to the presence of artificial light at night. Ethology. Accepted 30/1/19

Wilson, C. 2003. The use of translocations as a conservation strategy for the Growling Grass Frog, Litoria raniformis. 3rd year project report. Deakin University, Melbourne (unpublished).

FIGURES



Legend

- NGGA
- WGGA
- Railway
- Freeway
- Major Road
- Collector Road
- Minor Road
- Minor Watercourse
- Permanent Waterbody
- Land Subject to Inundation
- Ramsar wetland
- Parks and Reserves
- Commonwealth Land
- Crown Land
- Localities



Figure 1

Location of Northern and Western Geelong Growth Areas

Existing Conditions Assessment - Northern and Western Geelong Growth Areas

N

0 1,000 2,000

Metres

ecology & heritage partners

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

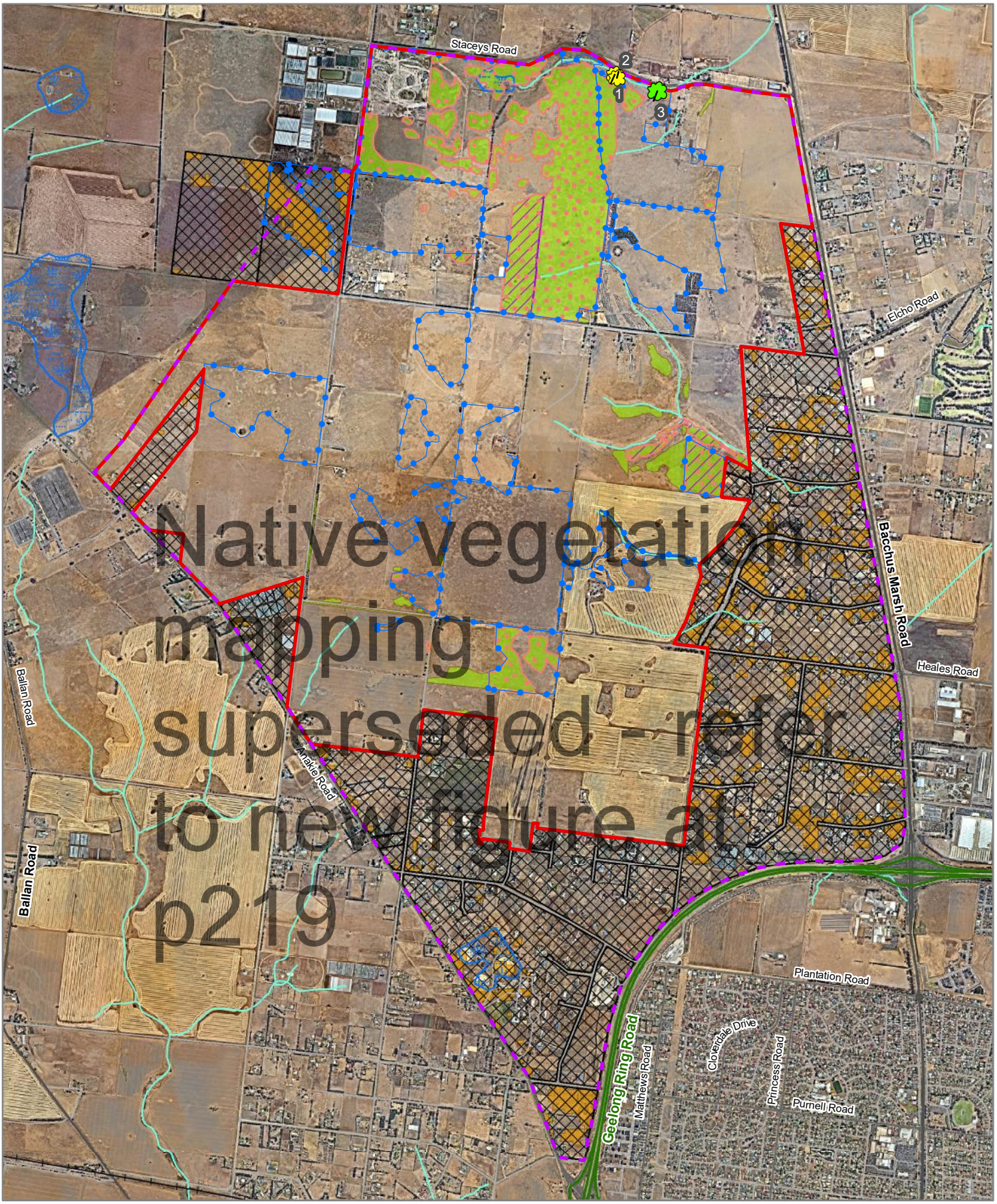


Figure 2 Overview

Ecological features

Existing Conditions Assessment - Northern Geelong Growth Area

Legend

- Study Area
- NGGA
- Current Wetlands
- No access
- Embedded rock
- Scattered Large Tree
- Scattered Small Tree

Ecological Vegetation Class

- Plains Grassland (EVC 132)

Modelled 2005 Ecological Vegetation Class

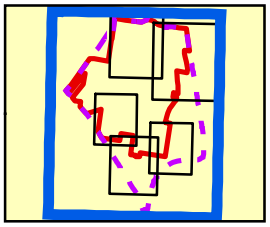
- Plains Grassland (EVC 132)

EPBC Act listed vegetation community

- Natural Temperate Grassland of the Victorian Volcanic Plain

FFG Act community

- Western (Basalt) Plains Grassland



N

0 300 600

Metres

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig02_EcolFeatN_PMB 2/07/2021 psorensen

ecology & heritage partners

Aerial source: Nearmap 2019



Figure 2a

Ecological features

Existing Conditions Assessment - Northern Geelong Growth Area

Legend

- Study Area
- NGGA
- Current Wetlands
- No access
- Embedded rock
- Scattered Large Tree
- Scattered Small Tree

Ecological Vegetation Class

- Plains Grassland (EVC 132)

Modelled 2005 Ecological Vegetation Class

- Plains Grassland (EVC 132)

EPBC Act listed vegetation community

- Natural Temperate Grassland of the Victorian Volcanic Plain

FFG Act community

- Western (Basalt) Plains Grassland

N

0 90 180

Metres

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig02_EcolFeatN_PMB 2/07/2021 psorensen

Aerial source: Nearmap 2019

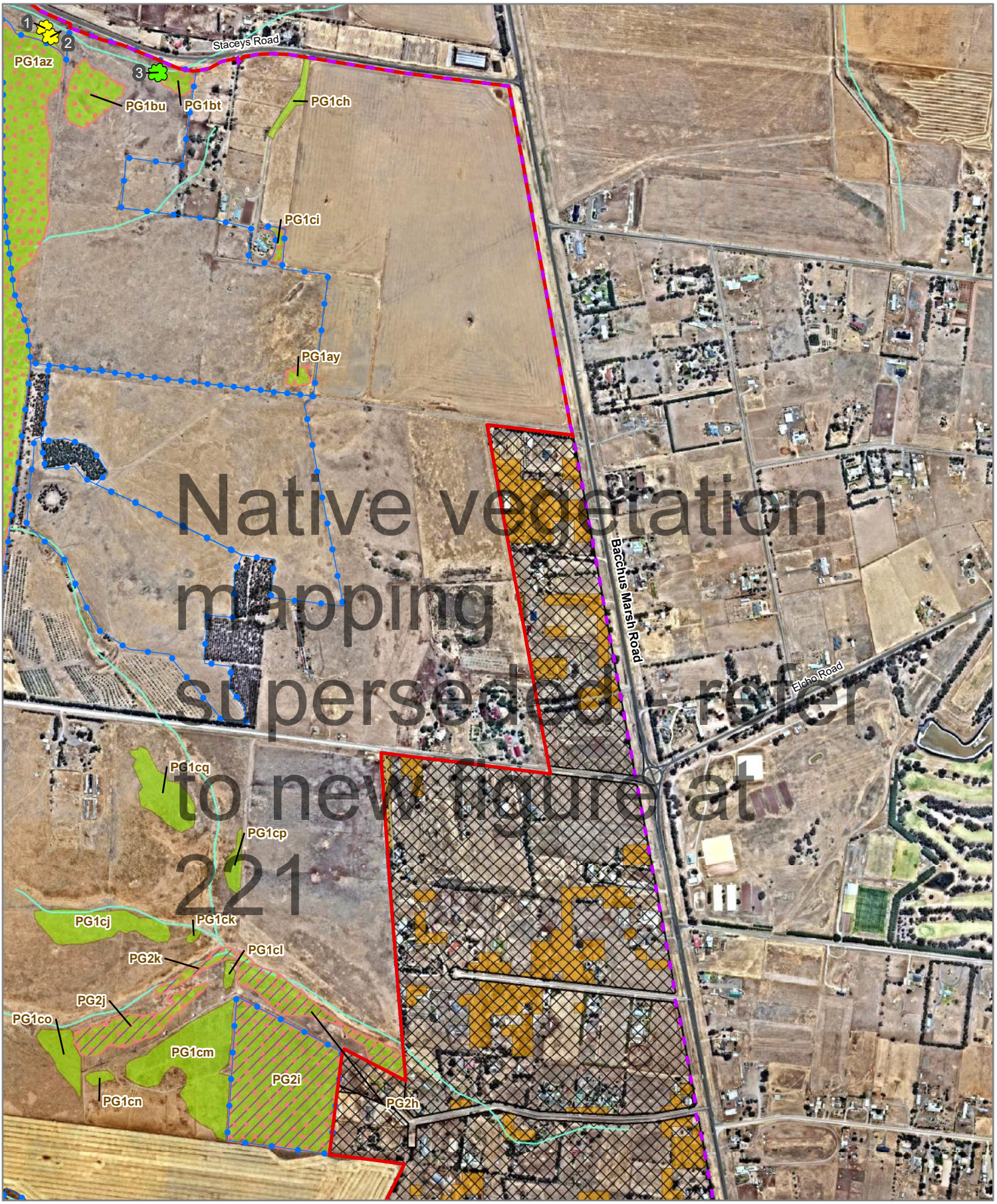


Figure 2b

Ecological features

Existing Conditions Assessment - Northern Geelong Growth Area

Legend

- Study Area
- NGGA
- No access
- Embedded rock
- Scattered Large Tree
- Scattered Small Tree

Ecological Vegetation Class

- Plains Grassland (EVC 132)

Modelled 2005 Ecological Vegetation Class

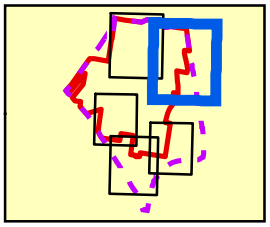
- Plains Grassland (EVC 132)

EPBC Act listed vegetation community

- Natural Temperate Grassland of the Victorian Volcanic Plain

FFG Act community

- Western (Basalt) Plains Grassland



N

0 112.5 225

Metres

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig02_EcolFeatN_PMB 2/07/2021 psorensen

ecology & heritage partners

Aerial source: Nearmap 2019



Figure 2c

Ecological features

Existing Conditions Assessment - Northern Geelong Growth Area

Legend

- Study Area
- NGGA
- No access
- Embedded rock

Ecological Vegetation Class

- Plains Grassland (EVC 132)

Modelled 2005 Ecological Vegetation Class

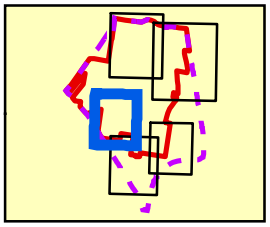
- Plains Grassland (EVC 132)

EPBC Act listed vegetation community

- Natural Temperate Grassland of the Victorian Volcanic Plain

FFG Act community

- Western (Basalt) Plains Grassland



N

0 75 150

Metres

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig02_EcolFeatN_PMB 2/07/2021 psorensen

ecology & heritage partners

Aerial source: Nearmap 2019

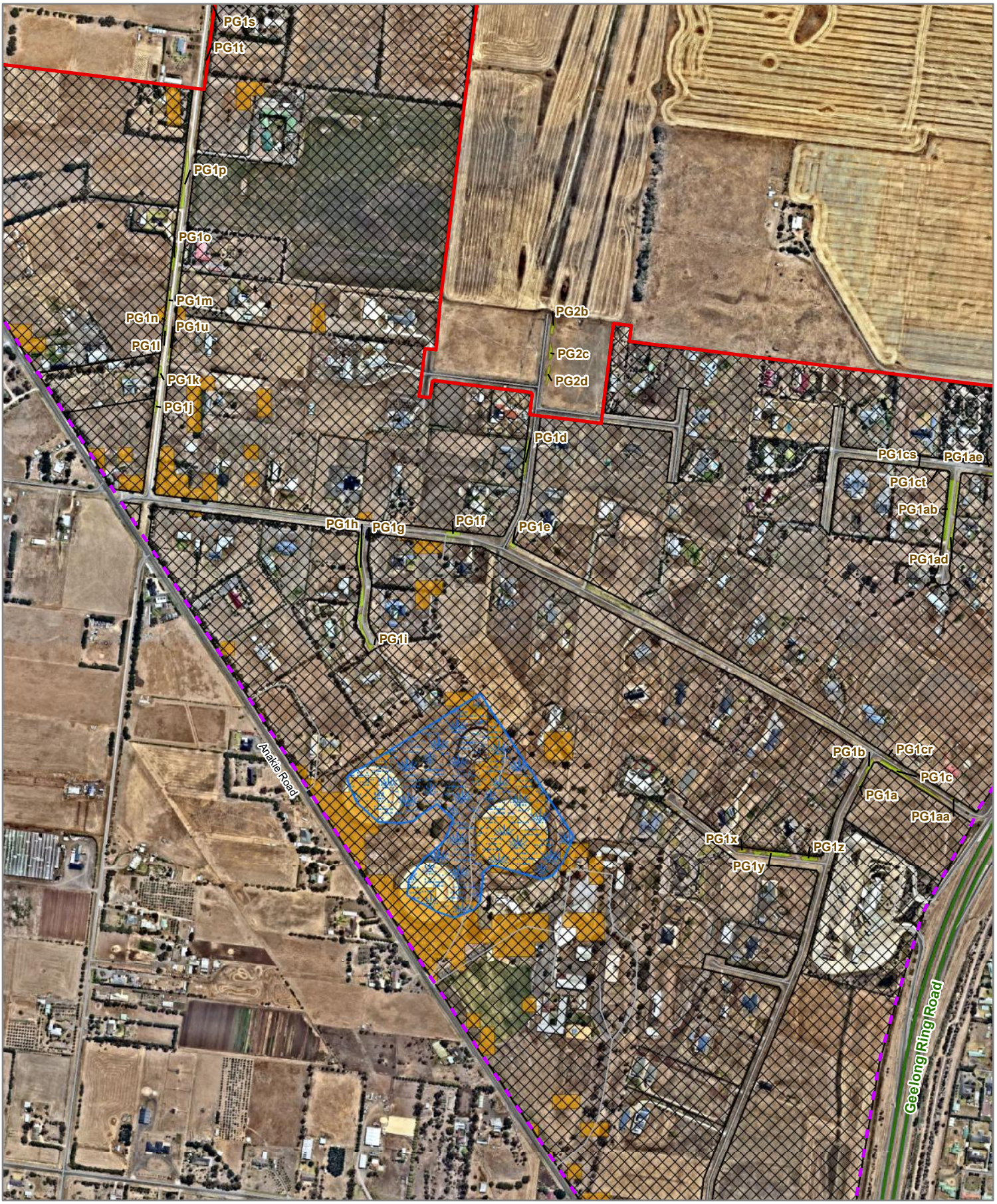


Figure 2d

Ecological features

Existing Conditions Assessment - Northern Geelong Growth Area

Legend

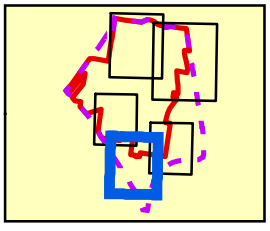
- Study Area
- NGGA
- Current Wetlands
- No access

Ecological Vegetation Class

- Plains Grassland (EVC 132)

Modelled 2005 Ecological Vegetation Class

- Plains Grassland (EVC 132)



N

0 85 170

Metres

ecology & heritage partners

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig02_EcolFeatN_PMB 2/07/2021 psorensen

Aerial source: Nearmap 2019

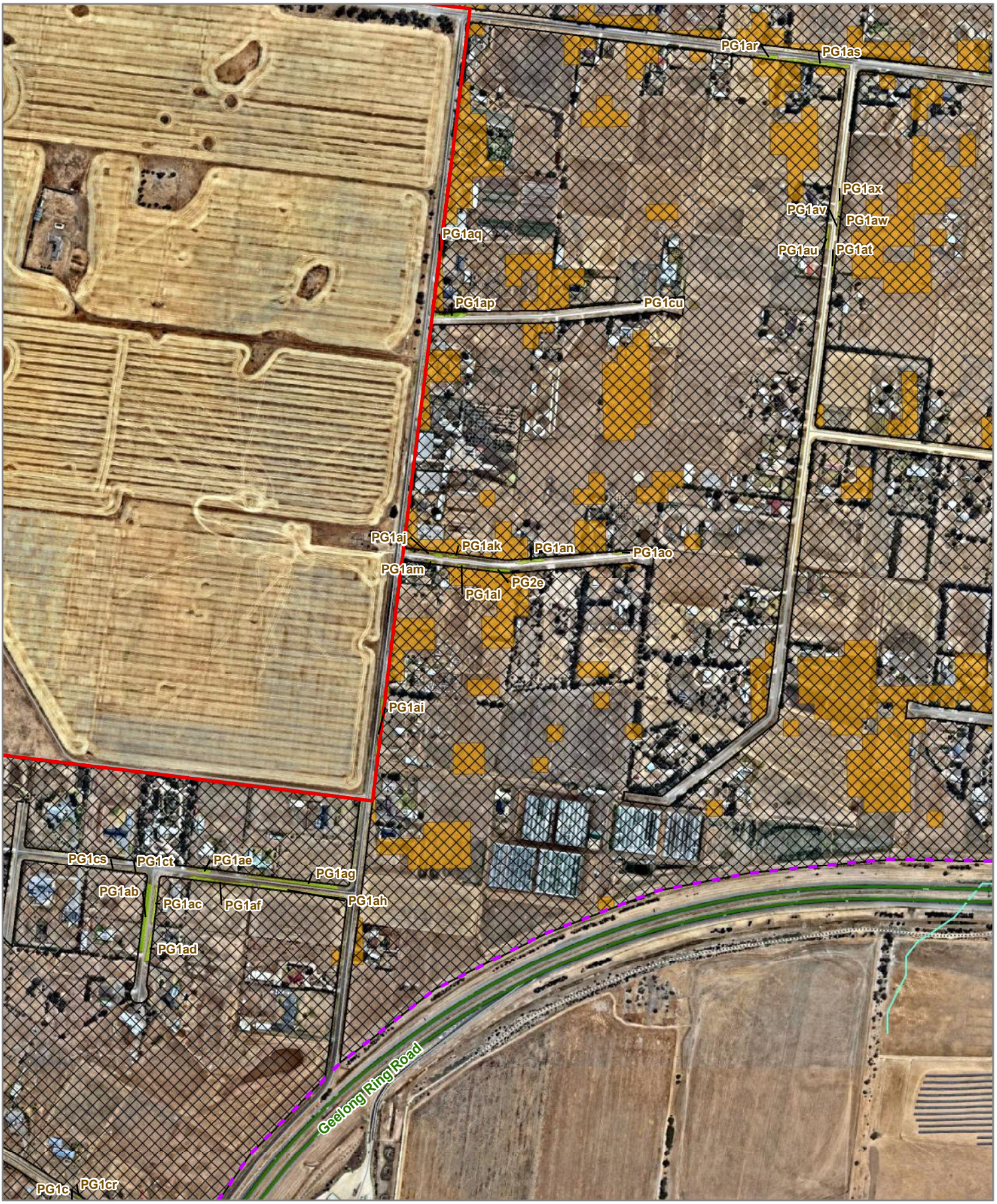


Figure 2e

Ecological features

Existing Conditions Assessment - Northern Geelong Growth Area

Legend

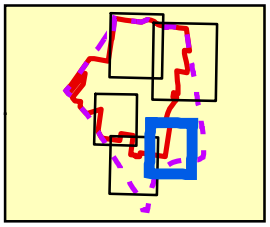
- Study Area
- NGGA
- No access

Ecological Vegetation Class

- Plains Grassland (EVC 132)

Modelled 2005 Ecological Vegetation Class

- Plains Grassland (EVC 132)



N

0 75 150

Metres

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

ecology & heritage partners

12896_Fig02_EcolFeatN_PMB 2/07/2021 psorensen

Aerial source: Nearmap 2019

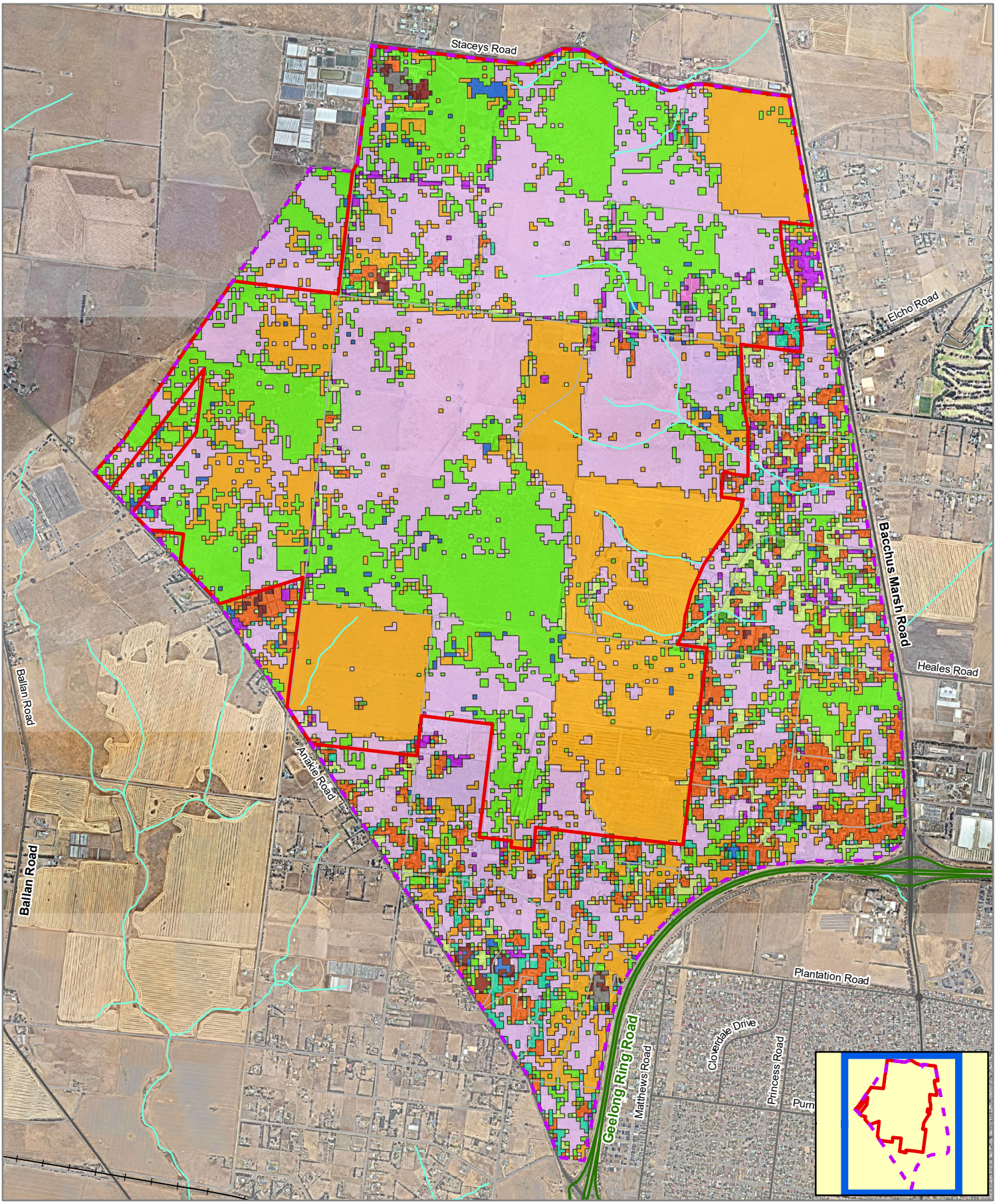


Figure 2f

Modelled Land Cover (2015-19) (DELWP)

Existing Conditions Assessment - Northern Geelong Growth Area

Legend

- Study Area
- NGGA

Land Cover Classes

- Built environment
- Conifer plantation
- Disturbed ground
- Dryland cropping
- Exotic pasture / grassland
- Hardwood plantation
- Horticulture / irrigated pastures and crops
- Native pasture / grassland
- Native scrubland
- Natural low cover
- Other exotic tree cover
- Scattered native trees
- Treed native vegetation
- Urban area
- Water
- Wetland - perennial
- Wetland - seasonal

N

0 300 600

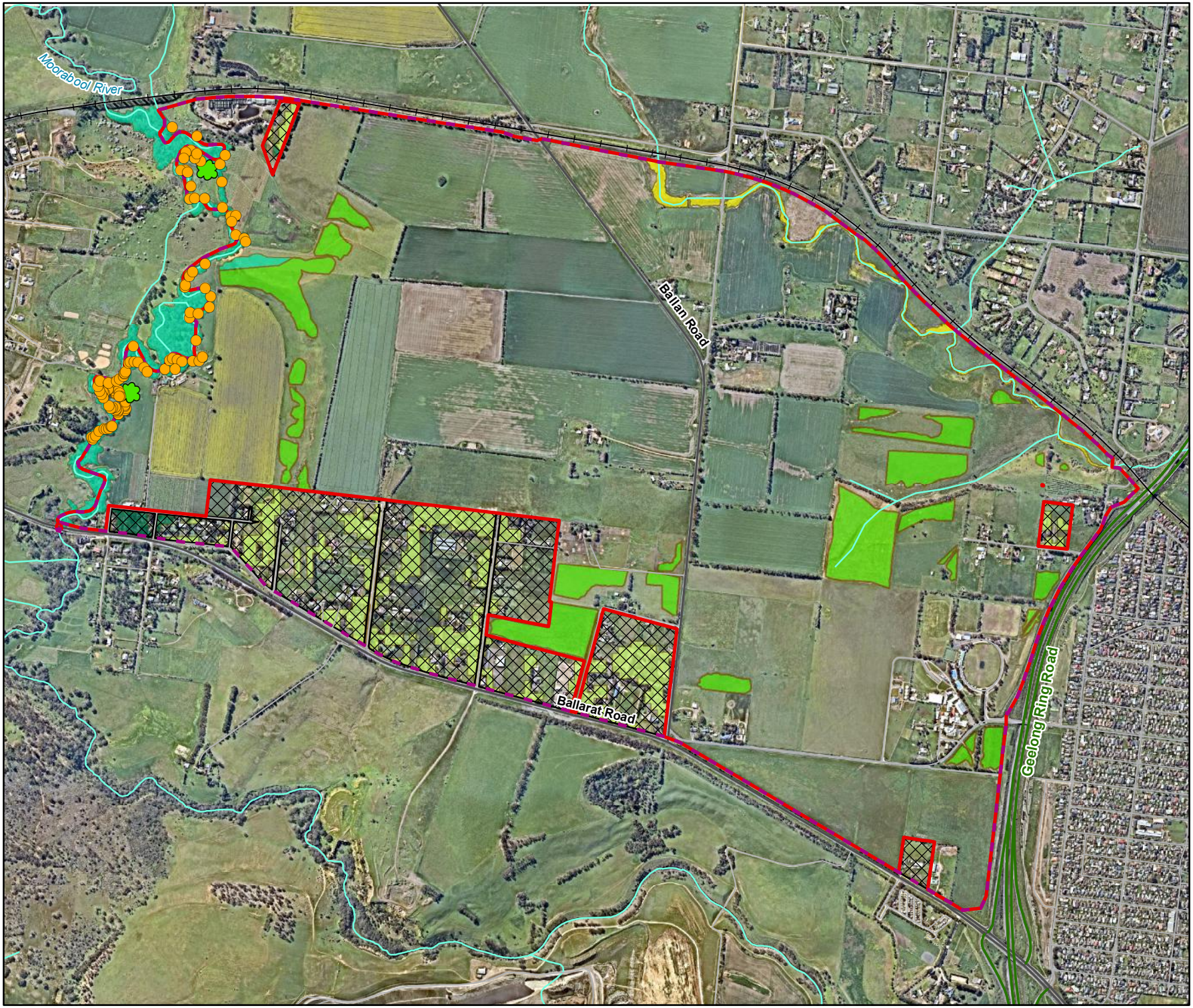
Metres

ecology & heritage partners

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig02f_LandcoverN_P 30/04/2021 melsley

Aerial source: Nearmap 2019



Legend

- Study Area
- WGGA
- No access
- Scattered LOT
- LOT in patch

Ecological Vegetation Class

- Creekline Grassy Woodland (EVC 68)
- Floodplain Riparian Woodland (EVC 56)
- Plains Grassland (EVC 132)

Modelled 2005 Ecological Vegetation Class

- Floodplain Riparian Woodland (EVC 56)
- Plains Grassland (EVC 132)

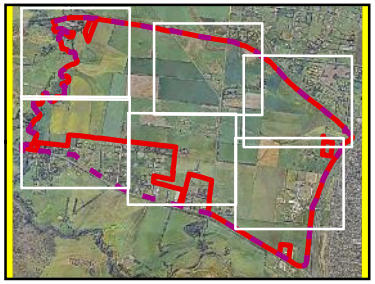


Figure 3 Overview

Ecological features

Existing Conditions Assessment - Western Geelong Growth Area

N

0 250 500

Metres

ecology & heritage partners

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig03_EcoFeatW_MB 2/07/2021 psorensen

Aerial source: Nearmap 2019



Legend

- Study Area
- WGGA
- No access
- Scattered LOT
- LOT in patch

Ecological Vegetation Class

- Floodplain Riparian Woodland (EVC 56)
- Plains Grassland (EVC 132)

Modelled 2005 Ecological Vegetation Class

- Floodplain Riparian Woodland (EVC 56)
- Plains Grassland (EVC 132)

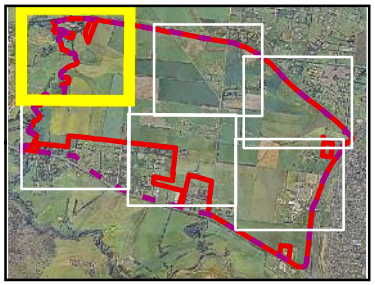


Figure 3a

Ecological features

Existing Conditions Assessment - Western Geelong Growth Area

N

0 70 140

Metres

ecology & heritage partners

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig03_EcoFeatW_MB 2/07/2021 psorensen

Aerial source: Nearmap 2019



Legend

- Study Area
- WGGA
- No access
- Scattered LOT
- LOT in patch

Ecological Vegetation Class

- Floodplain Riparian Woodland (EVC 56)
- Plains Grassland (EVC 132)

Modelled 2005 Ecological Vegetation Class

- Floodplain Riparian Woodland (EVC 56)
- Plains Grassland (EVC 132)

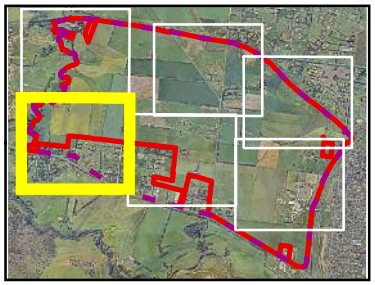


Figure 3b

Ecological features

Existing Conditions Assessment - Western Geelong Growth Area

N

0 70 140

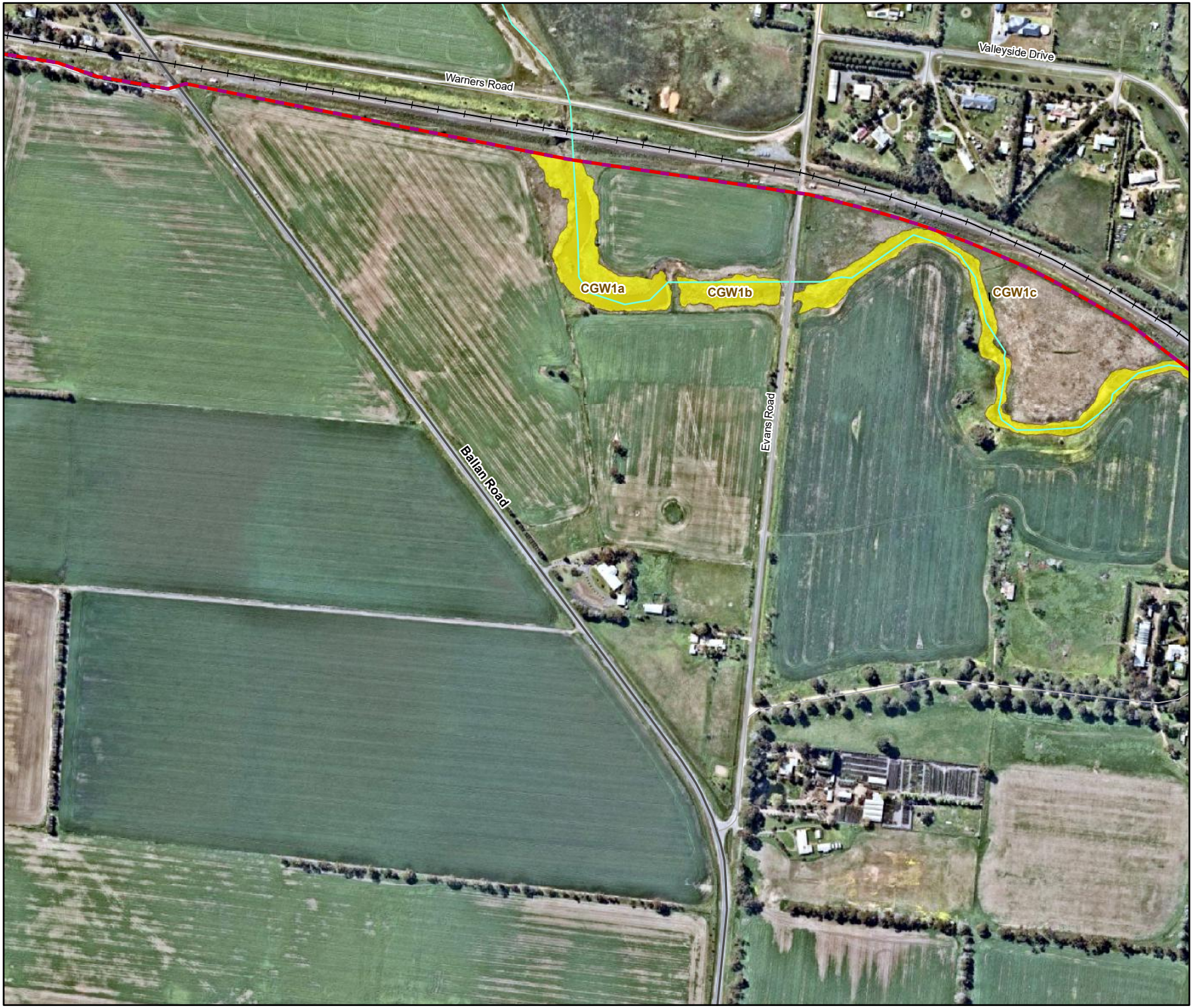
Metres

ecology & heritage partners

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig03_EcoFeatW_MB 2/07/2021 psorensen

Aerial source: Nearmap 2019



Legend

- Study Area
- WGGA

Ecological Vegetation Class

- Creekline Grassy Woodland (EVC 68)

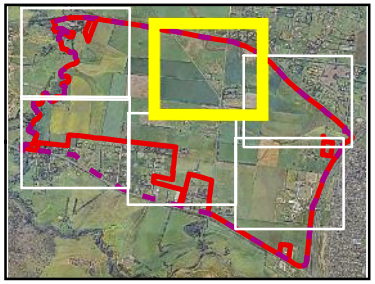


Figure 3c

Ecological features

Existing Conditions Assessment - Western Geelong Growth Area

N

0 70 140

Metres

ecology & heritage partners

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig03_EcoFeatW_MB 2/07/2021 psorensen

Aerial source: Nearmap 2019



Legend

- Study Area
- WGGA
- No access

Ecological Vegetation Class

- Plains Grassland (EVC 132)

Modelled 2005 Ecological Vegetation Class

- Plains Grassland (EVC 132)

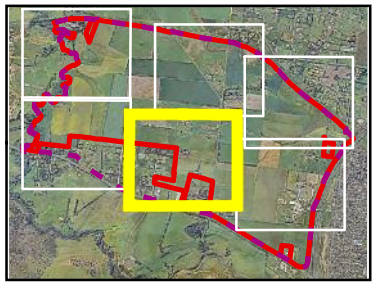


Figure 3d

Ecological features

Existing Conditions Assessment - Western Geelong Growth Area

N

0 70 140

Metres

ecology & heritage partners

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig03_EcoFeatW_MB 2/07/2021 psorensen

Aerial source: Nearmap 2019



Legend

- Study Area
- WGGA
- No access

Ecological Vegetation Class

- Creekline Grassy Woodland (EVC 68)
- Plains Grassland (EVC 132)

Modelled 2005 Ecological Vegetation Class

- Plains Grassland (EVC 132)

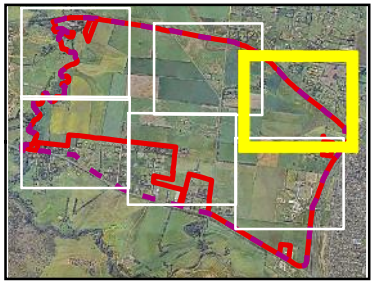


Figure 3e

Ecological features

Existing Conditions Assessment - Western Geelong Growth Area

N

0 70 140

Metres

ecology & heritage partners

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig03_EcoFeatW_MB 2/07/2021 psorensen

Aerial source: Nearmap 2019



Legend

- Study Area
- WGGA
- No access

Ecological Vegetation Class

- Plains Grassland (EVC 132)

Modelled 2005 Ecological Vegetation Class

- Plains Grassland (EVC 132)

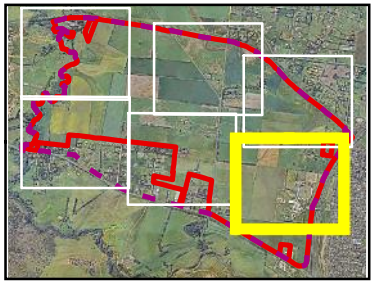


Figure 3f

Ecological features

Existing Conditions Assessment - Western Geelong Growth Area

N

0 70 140

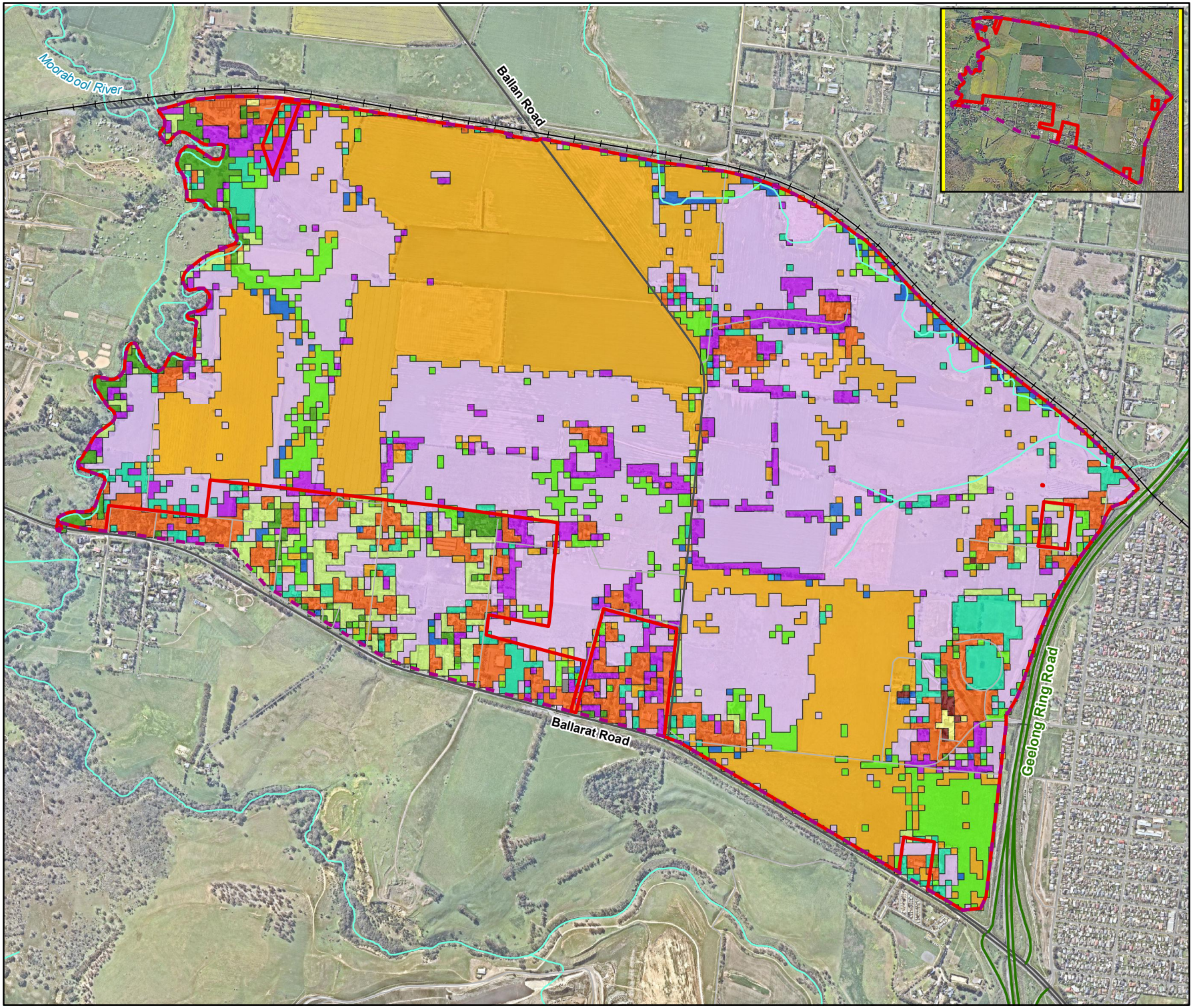
Metres

ecology & heritage partners

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig03_EcoFeatW_MB 2/07/2021 psorensen

Aerial source: Nearmap 2019



Legend

- Study Area
- WGGA

Land Cover Classes

- Built environment
- Conifer plantation
- Disturbed ground
- Dryland cropping
- Exotic pasture / grassland
- Hardwood plantation
- Horticulture / irrigated pastures and crops
- Native pasture / grassland
- Native scrubland
- Natural low cover
- Other exotic tree cover
- Scattered native trees
- Treed native vegetation
- Urban area
- Wetland - perennial
- Wetland - seasonal

Figure 3g

Modelled Land Cover (2015-19) (DELWP)

Existing Conditions Assessment - Western Geelong Growth Area

N

0 250 500

Metres

ecology & heritage partners

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig03g_LandCoverW 30/04/2021 melsley

Aerial source: Nearmap 2019

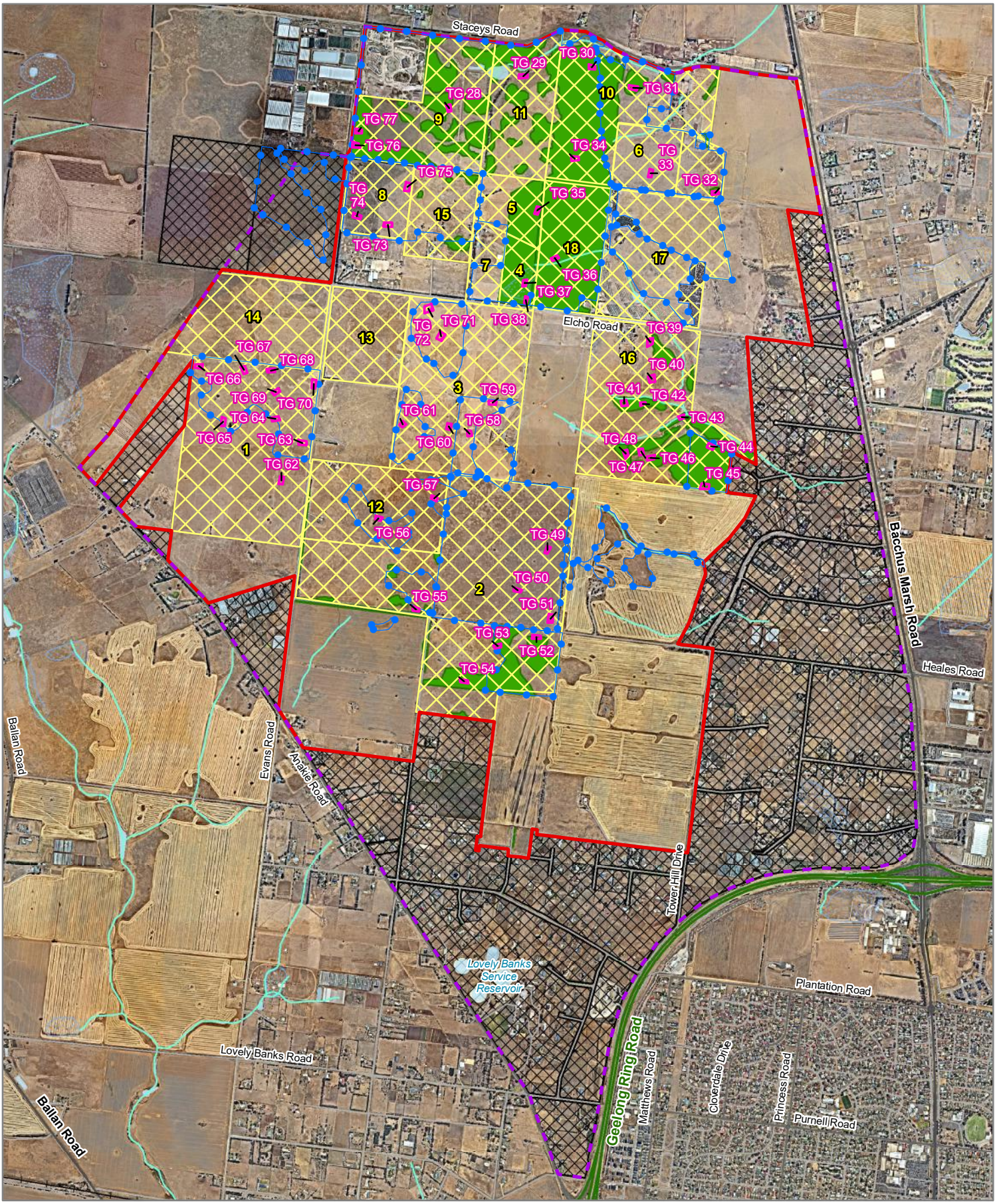


Figure 4a

Fauna survey effort

Existing Conditions Assessment - Northern Geelong Growth Area

Legend

- Study Area
- NGGA
- Striped Legless Lizard tile grid locations
- Parcels surveyed for Golden Sun Moth
- No access
- Embedded rock
- Areas of native vegetation



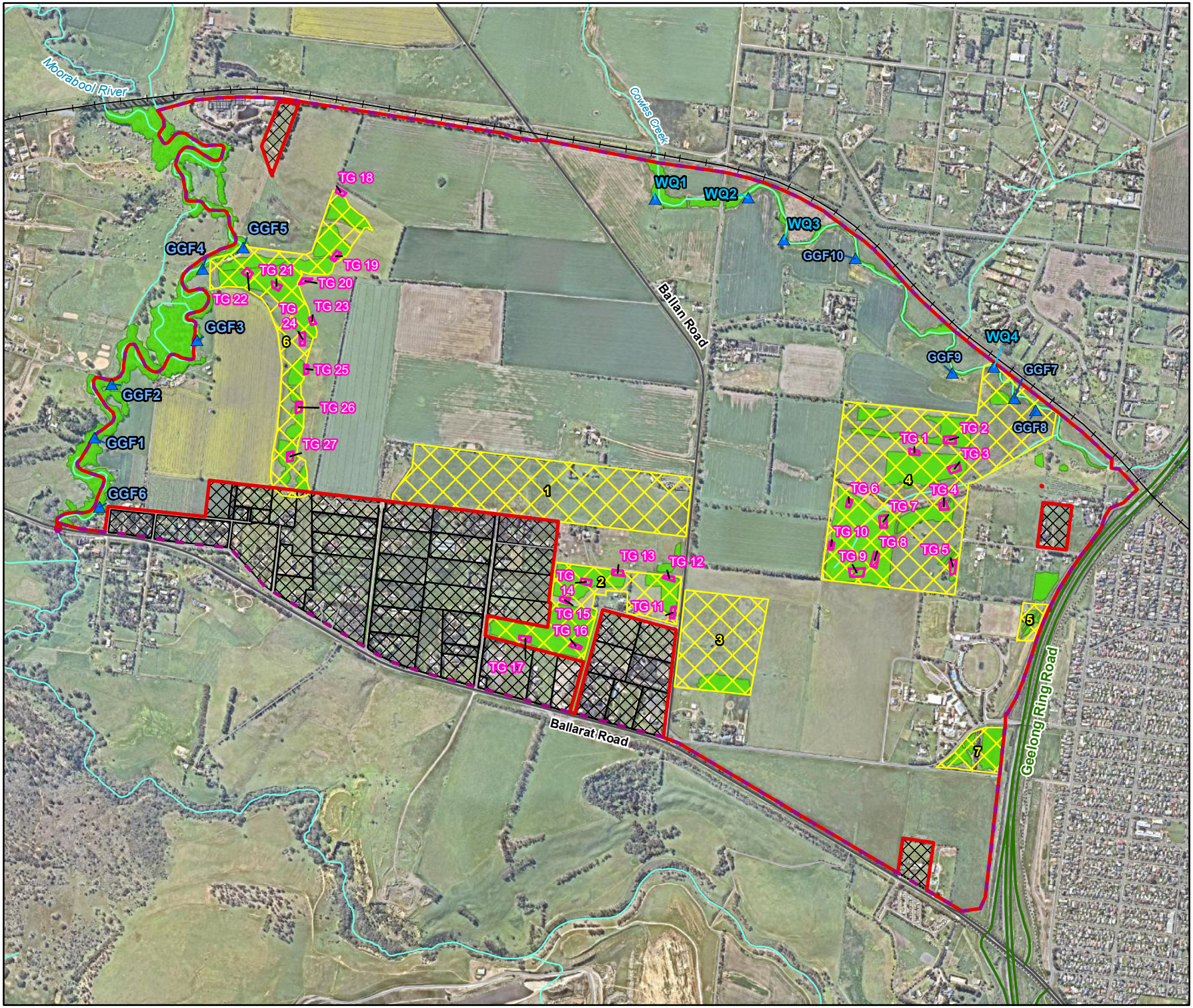
N

0 300 600
Metres

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig04a_FaunaSurvEffN 30/06/2021 melsley

Aerial source: Nearmap 2019



Legend

- Study Area
- WGGA
- No access
- Aquatic Surveys: Growling Grass Frog, Australian Grayling, water quality points
- Striped Legless Lizard tile grid locations
- Parcels surveyed for Golden Sun Moth
- Areas of native vegetation

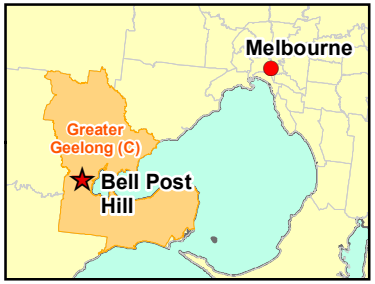


Figure 4b

Fauna survey effort

Existing Conditions Assessment - Western Geelong Growth Area

N

0 250 500

Metres

ecology & heritage partners

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig04b_FaunaSurvEffW 30/06/2021 melsley

Aerial source: Nearmap 2019

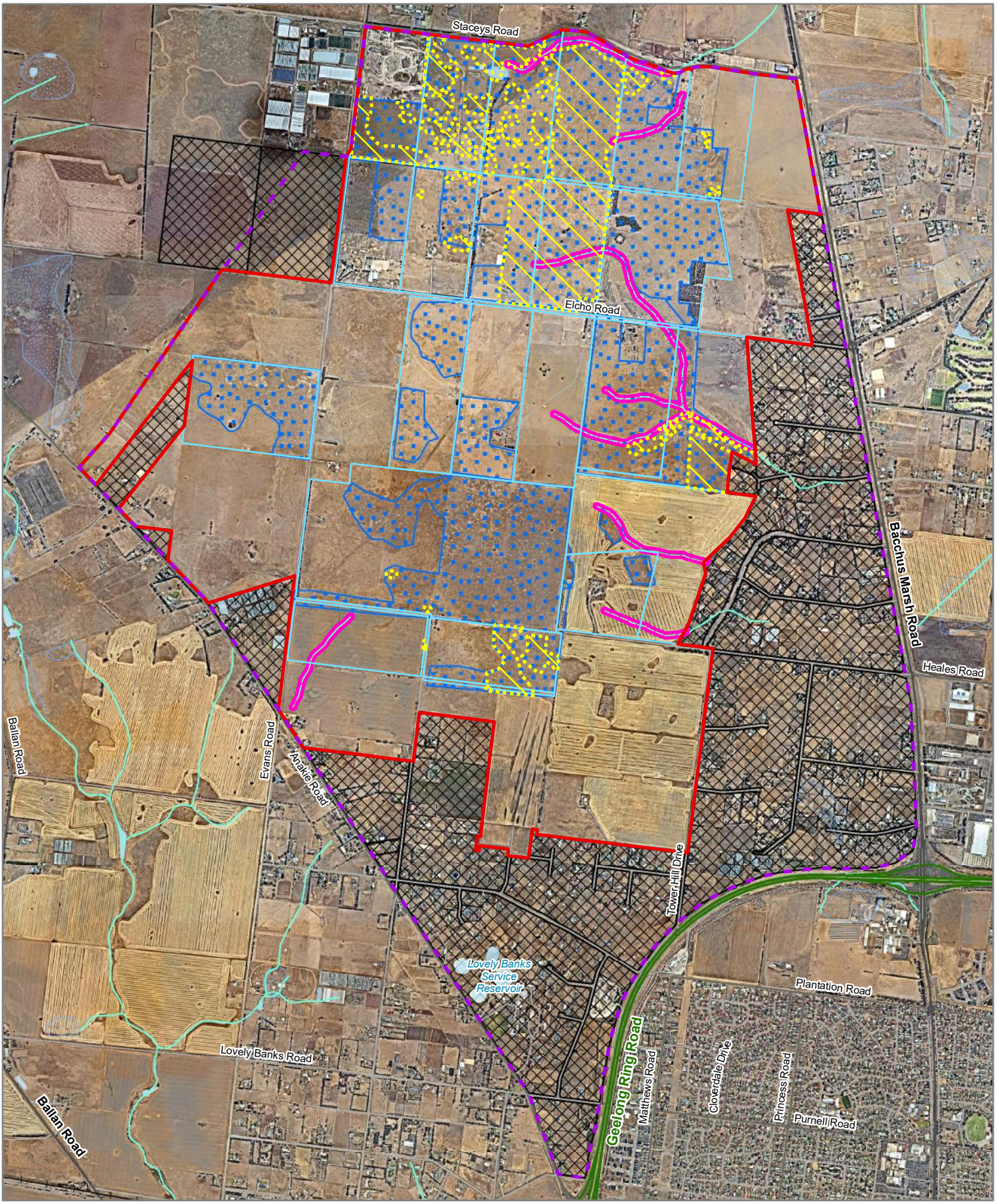


Figure 5a

Flora survey effort

Existing Conditions Assessment - Northern Geelong Growth Area

Legend

- Study Area
- NGGA
- Surveyed properties
- No access
- Adamson's Blown-grass survey area
- Spiny Rice-flower habitat (surveyed)
- Survey areas for Matted Flax-lily, Clover Clycine, Button Wrinklewort and Large-headed Fireweed



N

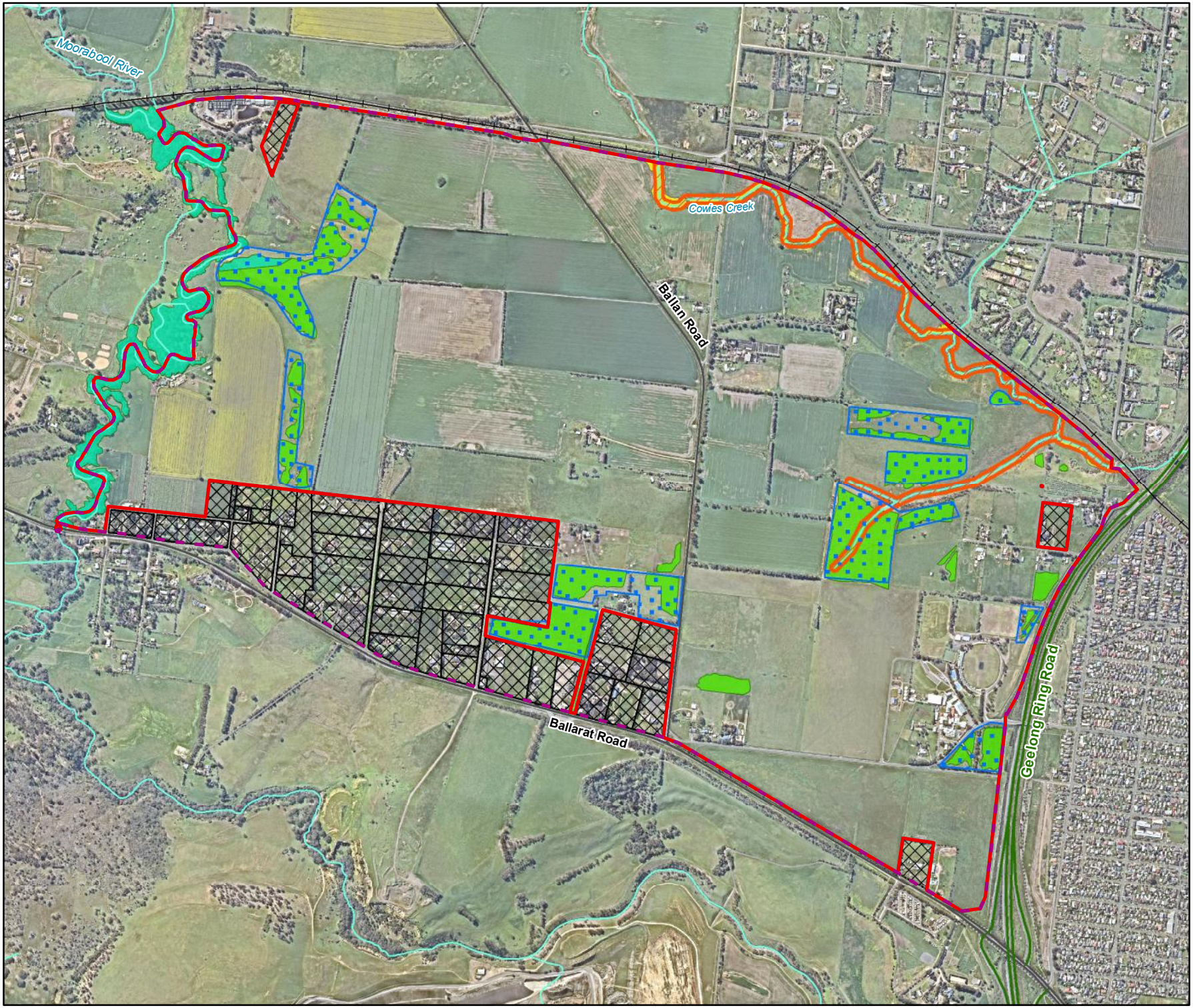
0 300 600
Metres

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

ecology & heritage partners

12896_Fig05a_FloraSurvEffN 30/06/2021 melsley

Aerial source: Nearmap 2019



Legend

- Study Area
- WGGA
- No access
- Adamson's Blown-grass survey area
- Spiny Rice-flower habitat (surveyed)

Areas of native vegetation

- Plains Grassland (PG1)
- Creekline Grassy Woodland
- Floodplain Riparian Woodland

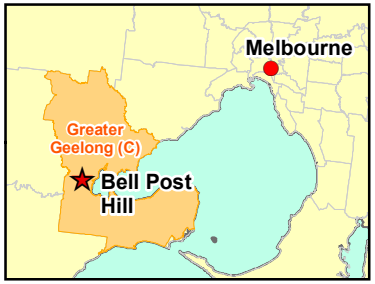


Figure 5b

Flora survey effort

Existing Conditions Assessment - Western Geelong Growth Area

N

0 250 500

Metres

ecology & heritage partners

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig05b_FloraSurvEffW 30/06/2021 melsley

Aerial source: Nearmap 2019

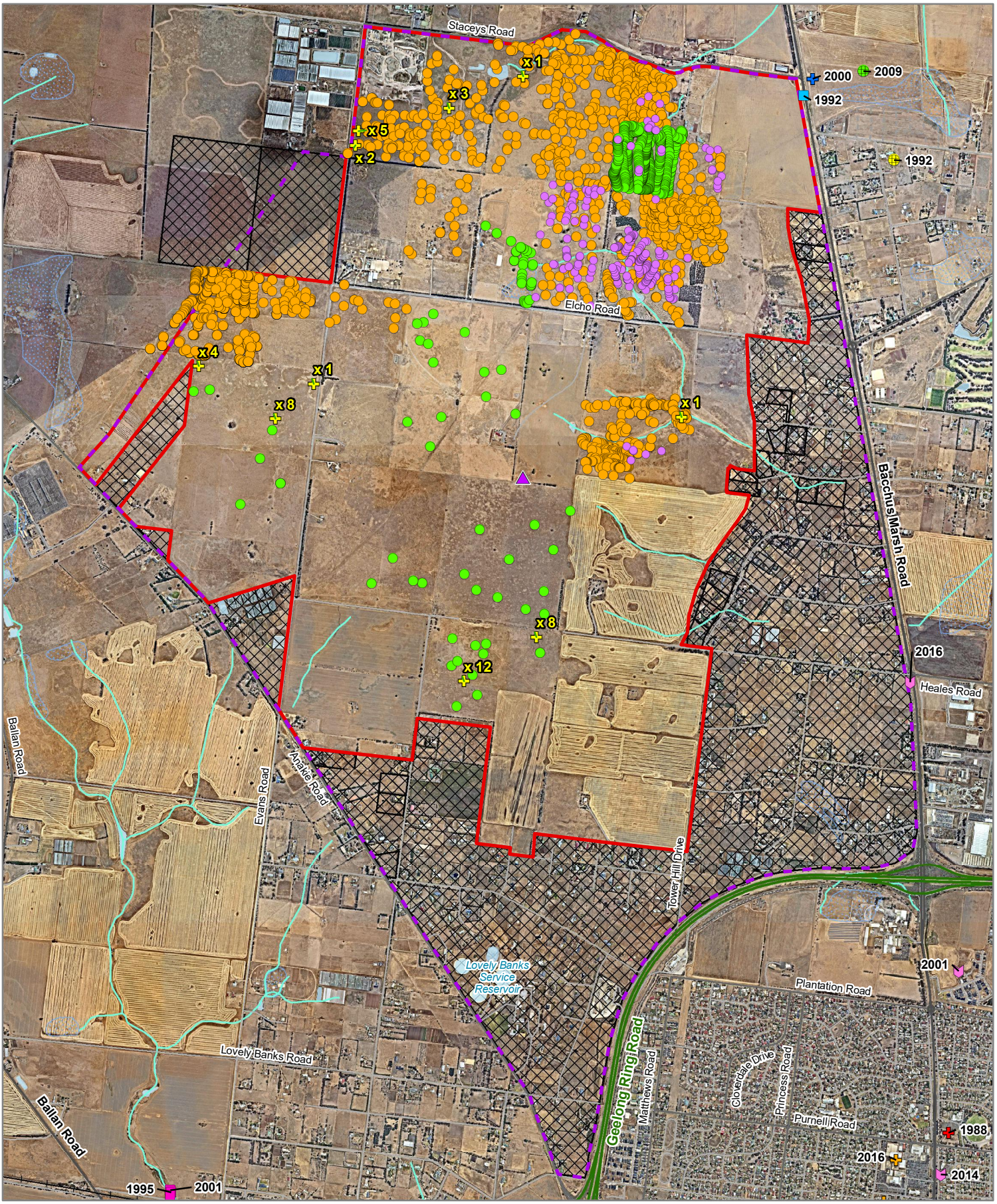


Figure 6a

Significant flora and fauna within the study area

Existing Conditions Assessment - Northern Geelong Growth Area

ecology & heritage partners

Legend

- Study Area
- NGGA
- No access

EHP records

- Golden Sun Moth (2020)
- Golden Sun Moth (2019)
- Golden Sun Moth (2015)
- Striped Legless Lizard (2020)
- Hard-headed Duck (2016)

Significant flora (VBA 2020)

National significance

- Adamson's Blown-grass

Regional significance

- Leafless Bluebush

Significant fauna (VBA 2020)

National significance

- Golden Sun Moth
- Striped Legless Lizard

State significance

- Yellow Sedge-skipper Butterfly
- Little Egret
- Black Falcon

Regional significance

- Spotted Harrier

N

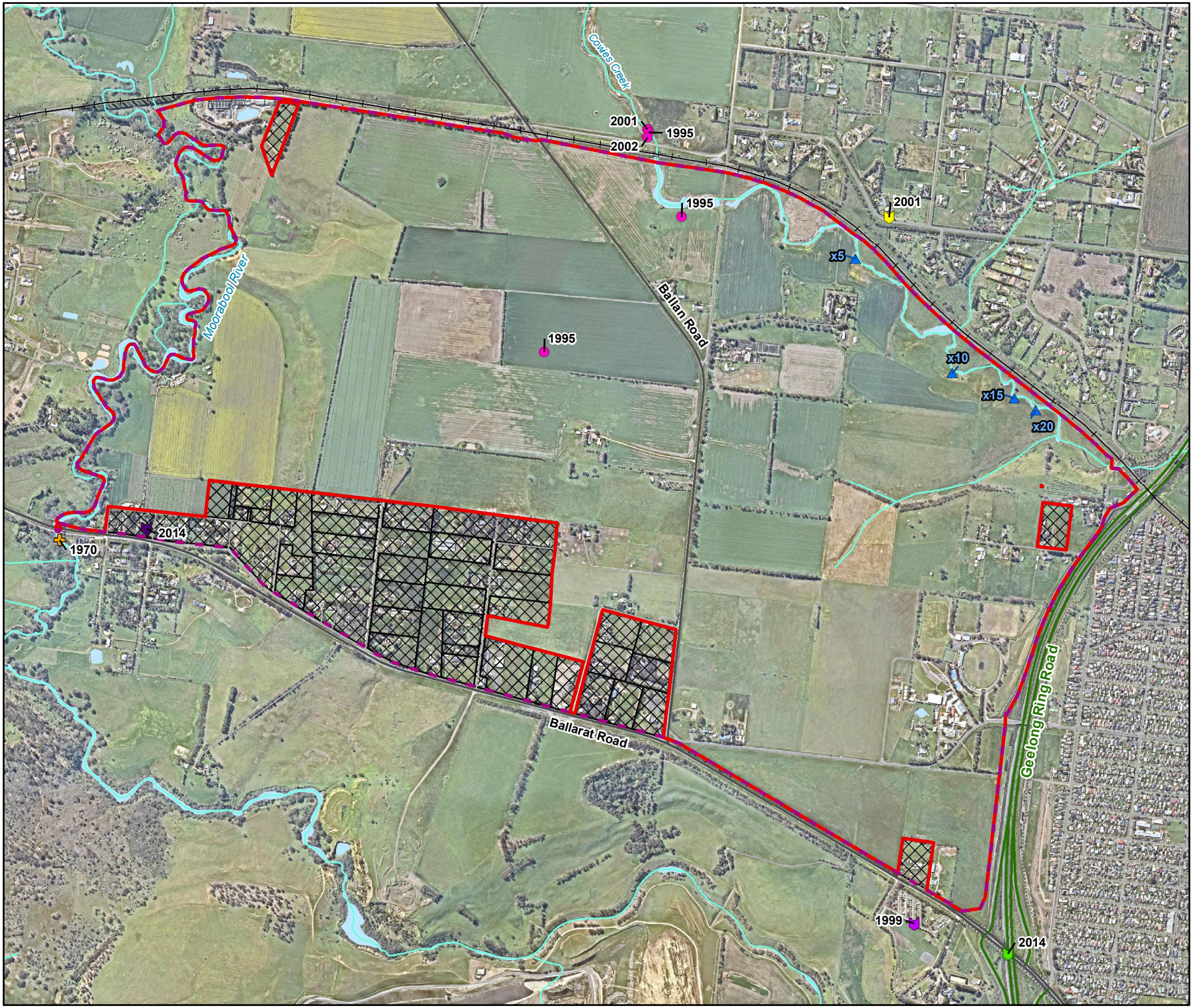
0 300 600

Metres

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig06a_SigSpeciesN_P 29/04/2021 psorensen

Aerial source: Nearmap 2019



Legend

- Study Area
- WGGA
- No access

EHP record (2019)

- Growling Grass Frog

Significant flora (VBA 2020)

National significance

- Adamson's Blown-grass

Significant fauna (VBA 2020)

National significance

- Macquarie Perch

State significance

- Grey Goshawk
- Black Falcon
- Great Egret
- White-bellied Sea-Eagle

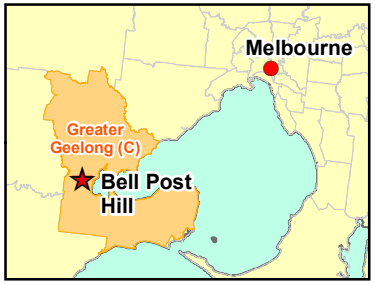


Figure 6b

Significant flora and fauna within the study area

Existing Conditions Assessment - Western Geelong Growth Area

N

0 250 500

Metres

ecology & heritage partners

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig06b_SigSpeciesW 29/04/2021 psorensen

Aerial source: Nearmap 2019

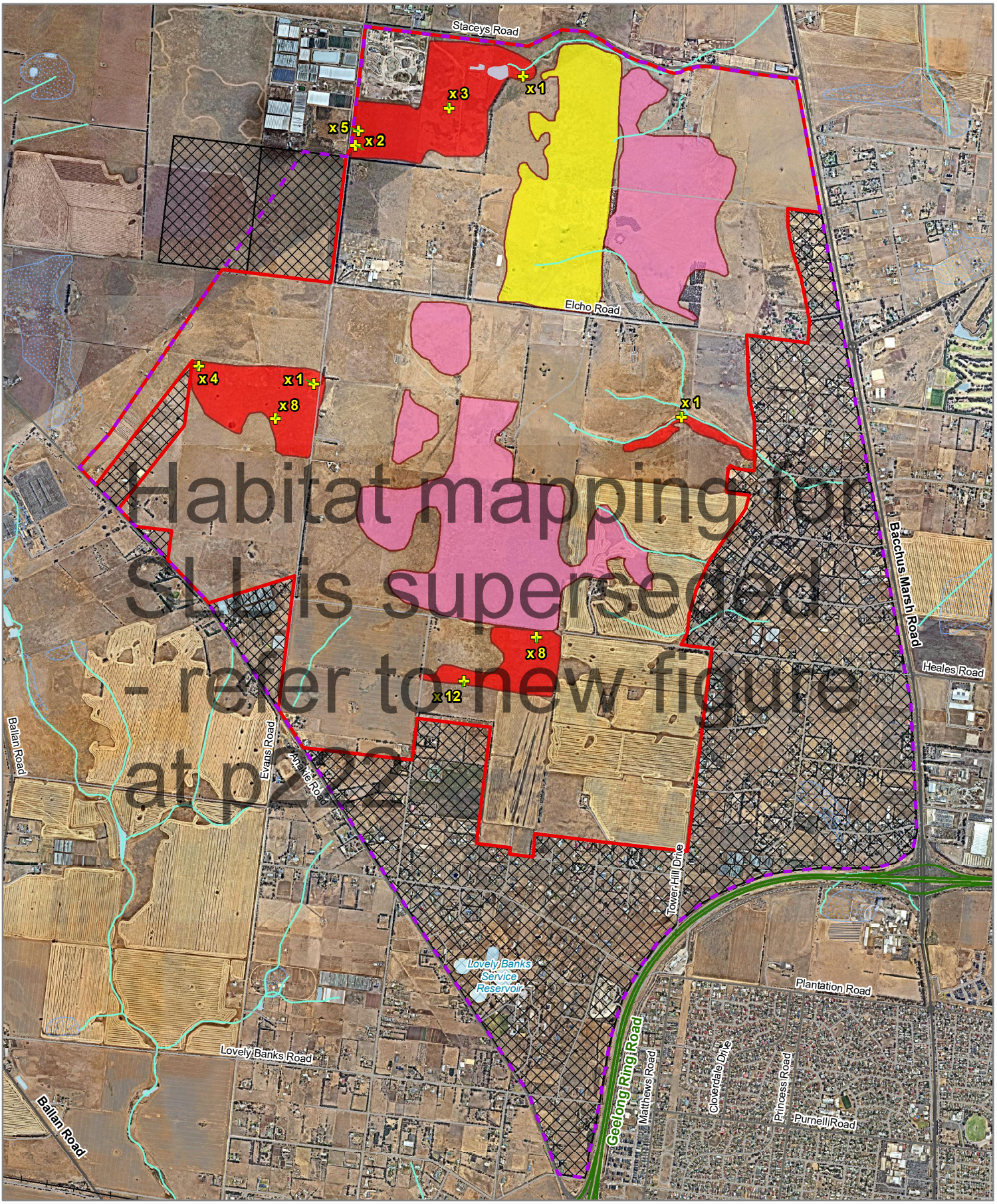


Figure 7

Striped Legless Lizard habitat

Existing Conditions Assessment - Northern Geelong Growth Area

Legend

- Study Area
- NGGA
- No access
- Confirmed Striped Legless Lizard habitat (SLL presence confirmed)
- Suitable Striped Legless Lizard habitat (native grassland although SLL presence not confirmed)
- Potential (low quality) Striped Legless Lizard habitat (exotic grassland SLL presence not confirmed)
- Striped Legless Lizard records (EHP 2020)



N

0 300 600
Metres

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig07_SLL_HabitatN 29/04/2021 psorensen

ecology & heritage partners

Aerial source: Nearmap 2019

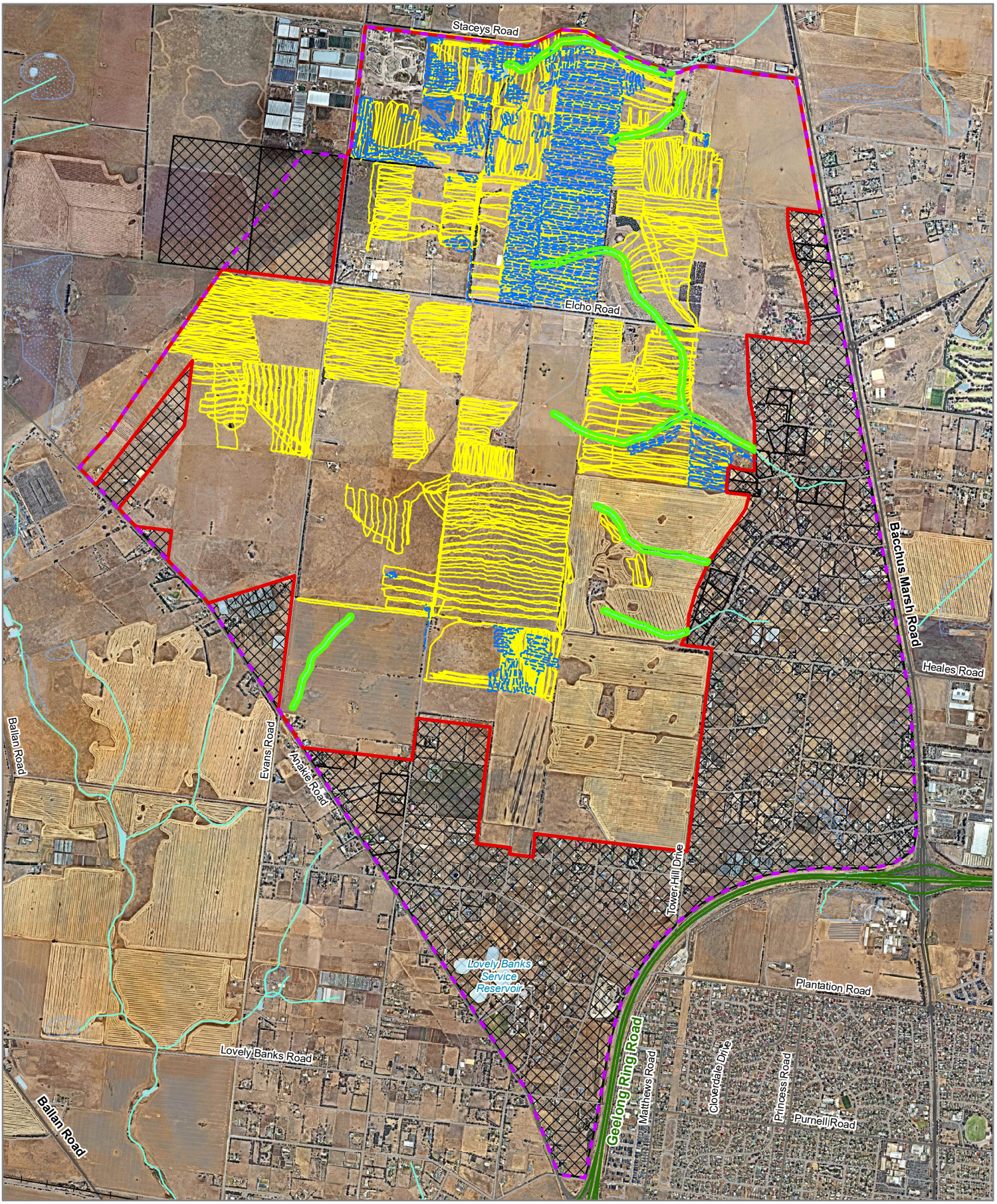


Figure 8a

Targeted flora survey tracks

Existing Conditions Assessment - Northern Geelong Growth Area

Legend

- Study Area
- NGGA
- No access
- Spiny Rice-flower survey tracks
- Survey tracks for Matted Flax-lily, Clover Glycine, Large-headed Fireweed and Button Wrinklewort
- Adamson's Blown-grass survey area



N

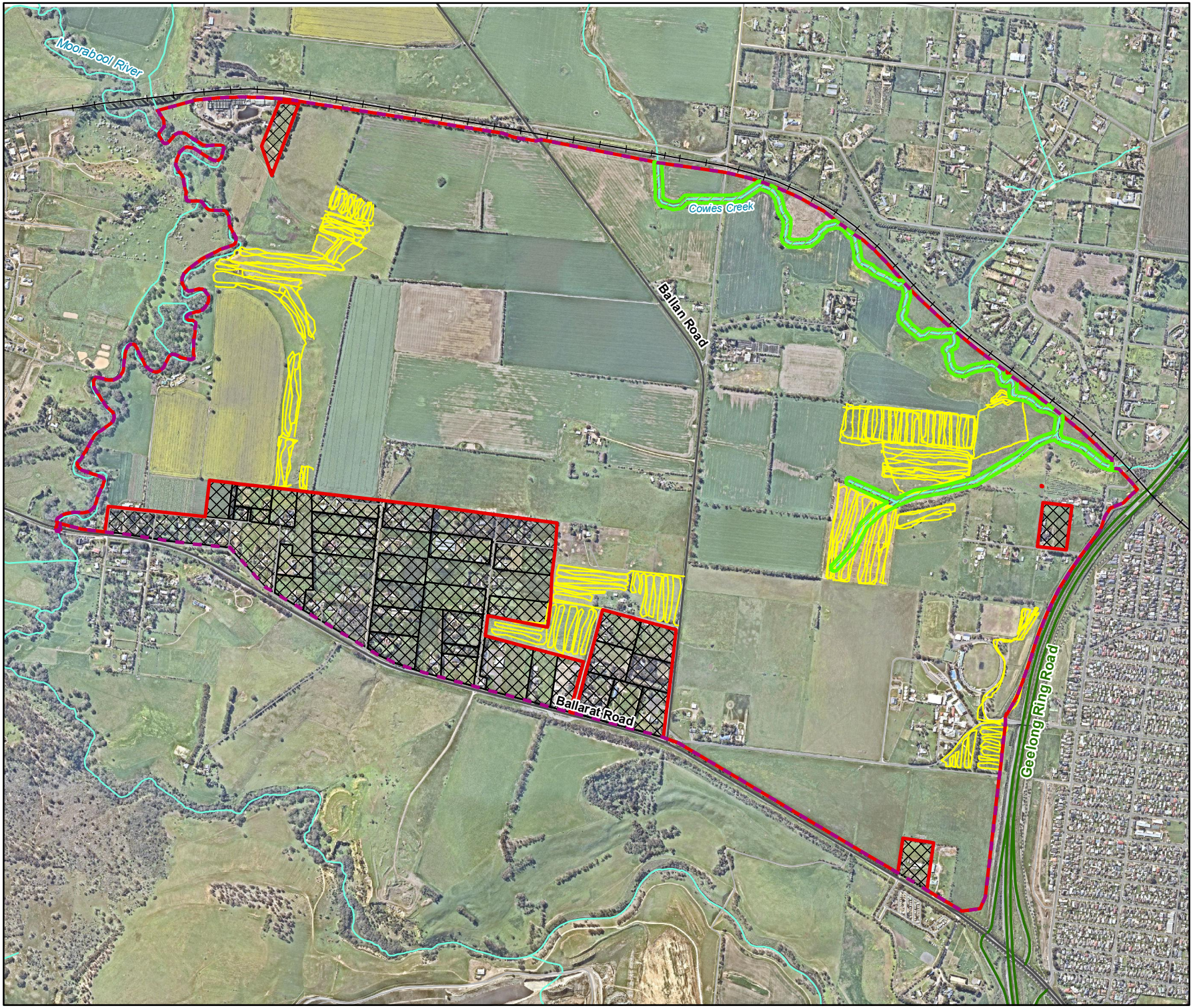
0 290 580
Metres

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig08a_TargFlora_TrksN 30/04/2021 melsley

ecology & heritage partners

Aerial source: Nearmap 2019



Legend

- Study Area
- WGGA
- Spiny Rice-flower survey tracks
- Adamson's Blown-grass survey area
- No access

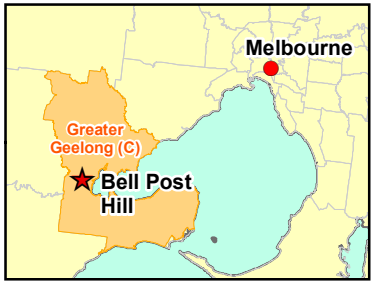


Figure 8b

Targeted flora survey tracks

Existing Conditions Assessment - Western Geelong Growth Area

N

0 250 500

Metres

ecology & heritage partners

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig08b_TargFlora_TrksW 30/04/2021 melsley

Aerial source: Nearmap 2019

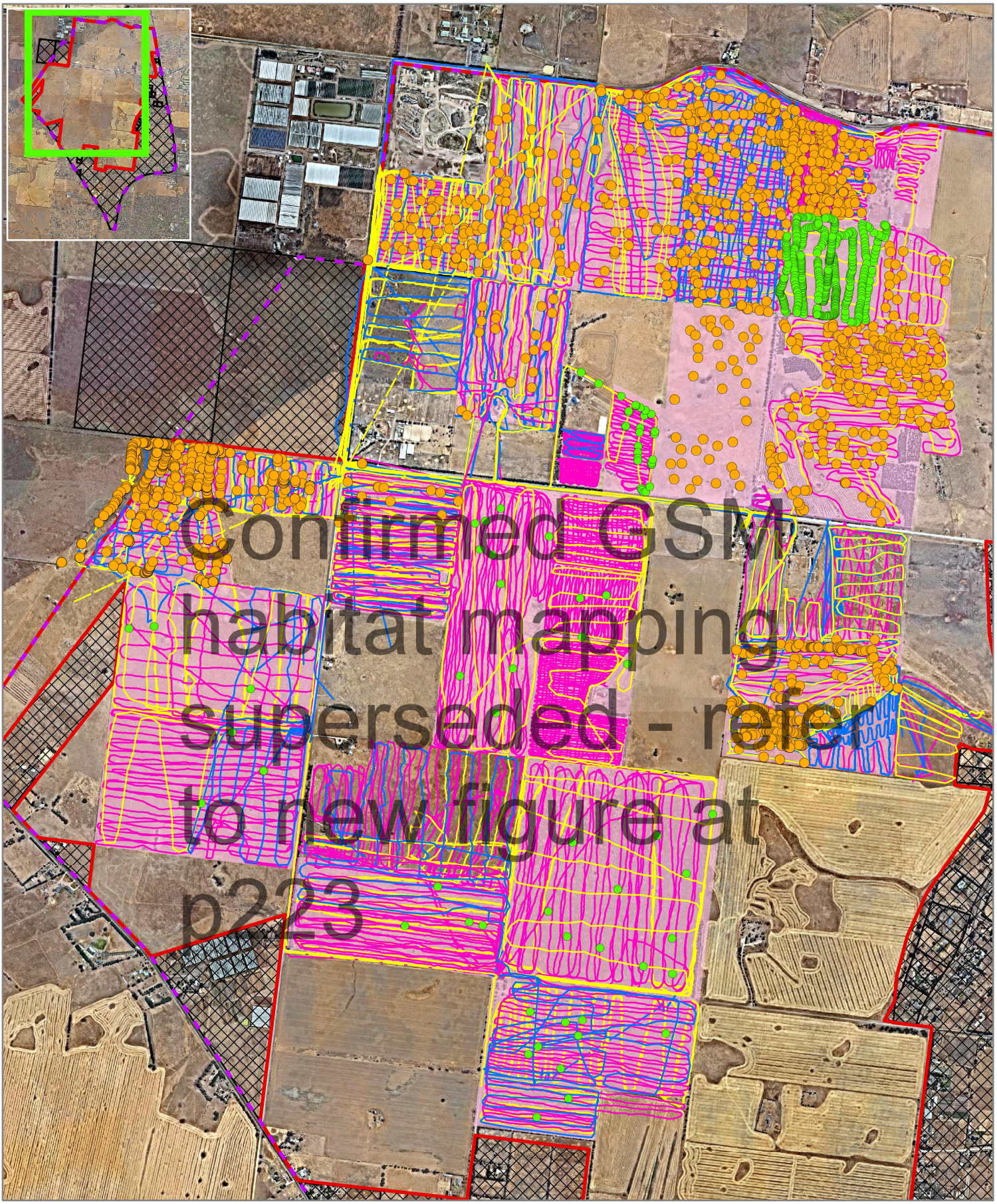


Figure 9a
Golden Sun Moth survey tracks
Existing Conditions Assessment - Northern Geelong Growth Area

Legend

- Study Area
- NGGA
- No access
- Golden Sun Moth records (2020)
- Golden Sun Moth records (2019)
- Confirmed Golden Sun Moth habitat

Survey tracks

- Survey 1 (50m)
- Survey 2 (25m)
- Surveys 3 and 4 (10m)



N

0 200 400
Metres

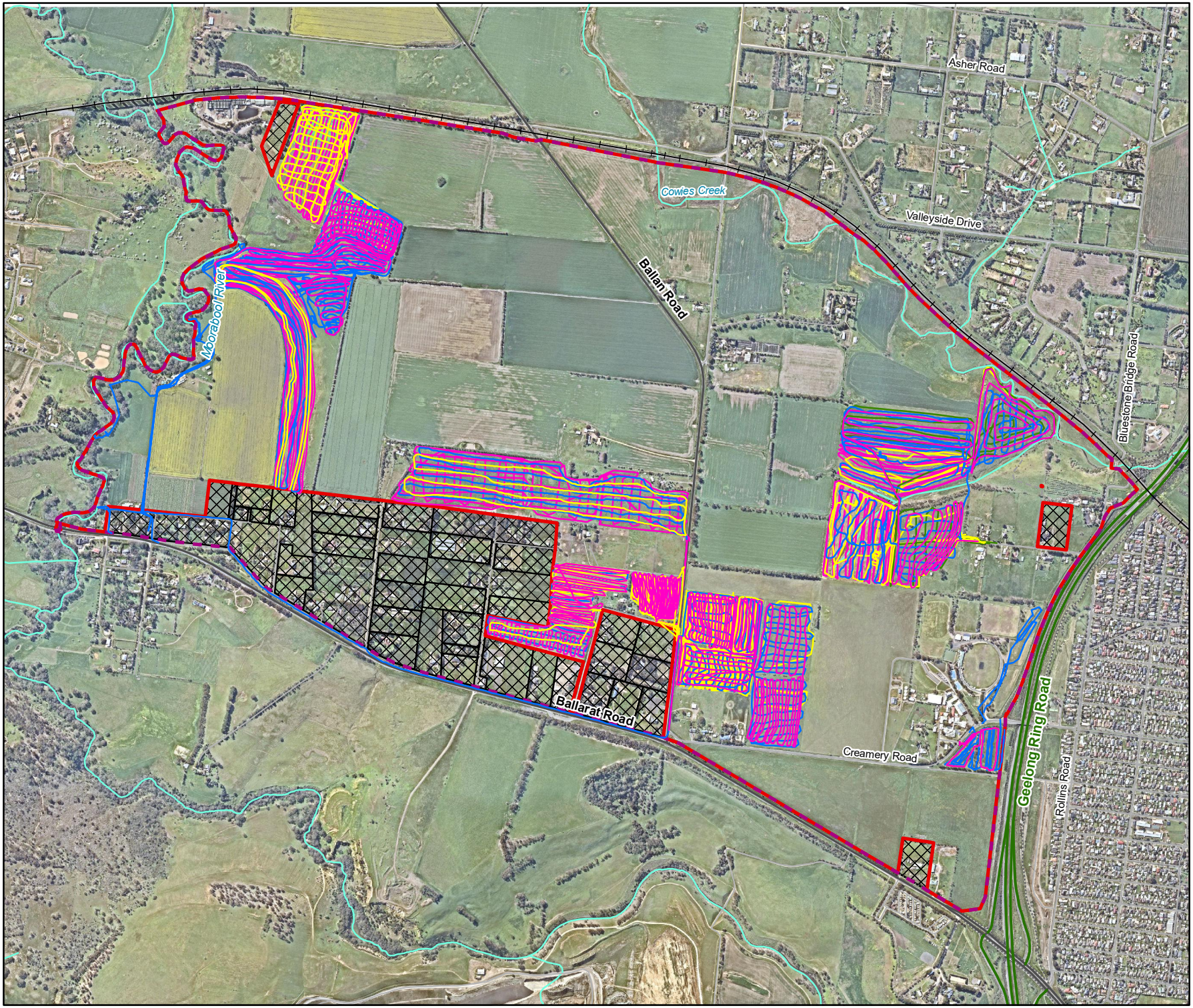
VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

ecology & heritage partners

12896_Fig09a_GSM_TracksN 29/04/2021 psorensen

12896_Fig09a_GSM_TracksN 29/04/2021 psorensen

Aerial source: Nearmap 2019



Legend

- Study Area
- WGGA
- No access

Survey tracks

- Survey 1 (50m)
- Survey 2 (25m)
- Survey 3 and 4 (10m)

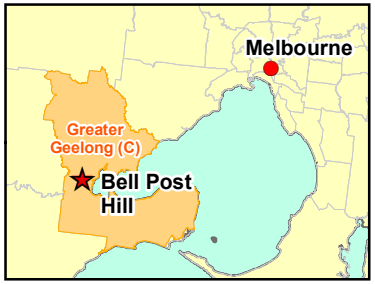


Figure 9b

Golden Sun Moth survey tracks

Existing Conditions Assessment - Western Geelong Growth Area

N

0 250 500

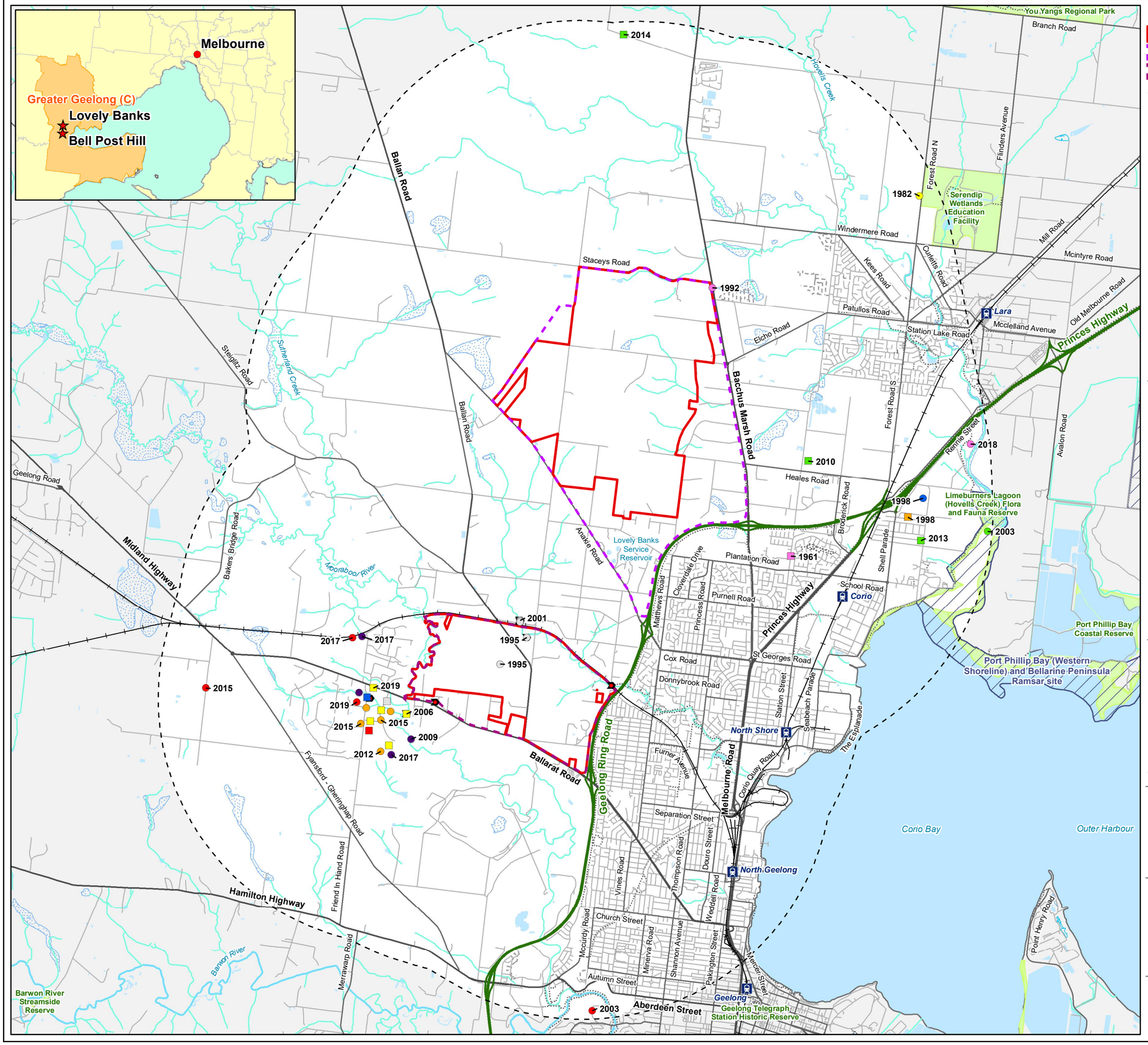
Metres

ecology & heritage partners

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

12896_Fig09b_GSM_TracksW 30/04/2021 melsley

Aerial source: Nearmap 2019



Legend

- Study Area
- NGGA
- WGGA

Significant flora

- Adamson's Blown-grass
- Fragrant Saltbush
- Giant Honey-myrtle
- Glistening Dock
- Grey Mangrove
- Large-headed Fireweed
- Leafless Bluebush
- Melbourne Yellow-gum
- Mugga
- Rosemary Grevillea
- Rye Beetle-grass
- Snowy Mint-bush
- Spiny Rice-flower
- Spotted Gum
- Straw Wallaby-grass

Atlas of Living Australia

- Adamson's Blown-grass
- Fragrant Saltbush
- Snowy Mint-bush

Figure 10

Previously documented significant flora within 5km of the study area

Existing Conditions Assessment - Northern and Western Geelong Growth Areas

N

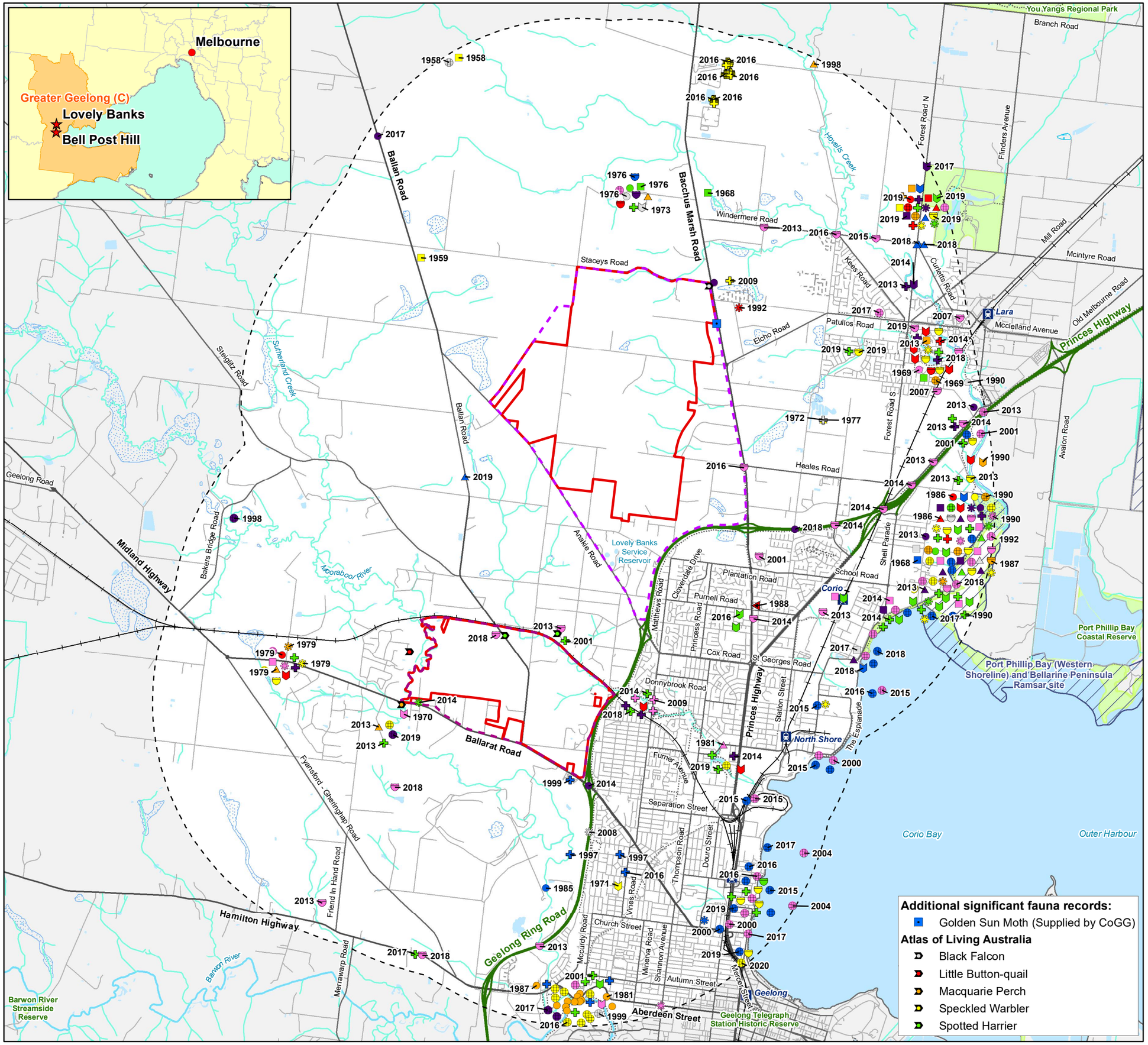
0 2 4

Kilometres

ecology & heritage partners

Victorian Biodiversity Atlas (VBA) // Sourced from: 'VBA_FLORA25', 'VBA_FLORA100', 'VBA_FAUNA25' and 'VBA_FAUNA100', Updated March 2021 © The State of Victoria, Department of Environment, Land, Water and Planning. Records prior to 1949 not shown.

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.



Legend

- Study Area
- NGGA
- WGGA

Significant fauna

- Australasian Bittern
- Australasian Shoveler
- Australian Grayling
- Australian Little Bittern
- Azure Kingfisher
- Baillon's Crake
- Barking Owl
- Black Falcon
- Black-faced Cormorant
- Black-tailed Godwit
- Blue-billed Duck
- Brolga
- Brown Treecreeper
- Bryde's Whale
- Caspian Tern
- Common Greenshank
- Common Sandpiper
- Curlew Sandpiper
- Diamond Firetail
- Eastern Barred Bandicoot
- Eastern Curlew
- Emu
- Fairy Prion
- Fairy Tern
- Fat-tailed Dunnart
- Freckled Duck
- Glossy Ibis
- Golden Sun Moth
- Great Egret
- Grey Goshawk
- Growling Grass Frog
- Hardhead
- Hooded Robin
- Latham's Snipe
- Lewin's Rail
- Little Button-quail
- Little Egret
- Little Tern
- Macquarie Perch
- Magpie Goose
- Major Mitchell's Cockatoo
- Marsh Sandpiper
- Musk Duck
- Nankeen Night-Heron
- Orange-bellied Parrot
- Pacific Gull
- Pied Cormorant
- Platypus
- Plumed Egret
- Powerful Owl
- Red Knot
- Royal Spoonbill
- Southern Humpback Whale
- Speckled Warbler
- Spotted Harrier
- Spotted Quail-thrush
- Square-tailed Kite
- Striped Legless Lizard
- Swift Parrot
- Whiskered Tern
- White-bellied Sea-Eagle
- White-faced Storm-Petrel
- White-throated Needletail
- White-winged Black Tern
- Yellow Sedge-skipper Butterfly

Additional significant fauna records:

- Golden Sun Moth (Supplied by CoGG)

Atlas of Living Australia

- Black Falcon
- Little Button-quail
- Macquarie Perch
- Speckled Warbler
- Spotted Harrier

Figure 11

Previously documented significant fauna within 5km of the study area

Existing Conditions Assessment - Northern and Western Geelong Growth Areas

N

0 2 4

Kilometres

ecology & heritage partners

Victorian Biodiversity Atlas (VBA) // Sourced from: 'VBA_FLORA25', 'VBA_FLORA100', 'VBA_FAUNA25' and 'VBA_FAUNA100', Updated March 2021 © The State of Victoria, Department of Environment, Land, Water and Planning. Records prior to 1949 not shown.

VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

APPENDICES

APPENDIX 1

Appendix 1.1 – Rare or Threatened Categories for Listed Victorian Taxa

Table A1.1. Rare or Threatened categories for listed Victorian taxa.

Rare or Threatened Categories
Conservation Status in Australia (Based on the EPBC Act 1999)
EX - Extinct: Extinct is when there is no reasonable doubt that the last individual of the species has died.
CR - Critically Endangered: A species is critically endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.
EN - Endangered: A species is endangered when it is not critically endangered but is facing a very high risk of extinction in the wild in the near future.
VU - Vulnerable: A species is vulnerable when it is not critically endangered or endangered but is facing a high risk of extinction in the wild in the medium-term future.
R* - Rare: A species is rare but overall is not currently considered critically endangered, endangered or vulnerable.
K* - Poorly Known: A species is suspected, but not definitely known, to belong to any of the categories extinct, critically endangered, endangered, vulnerable or rare.
Conservation Status in Victoria (Based on DEPI 2014, DSE 2009 or2013)
x - Presumed Extinct in Victoria: not recorded from Victoria during the past 50 years despite field searches specifically for the plant, or, alternatively, intensive field searches (since 1950) at all previously known sites have failed to record the plant.
e - Endangered in Victoria: at risk of disappearing from the wild state if present land use and other causal factors continue to operate.
v - Vulnerable in Victoria: not presently endangered but likely to become so soon due to continued depletion; occurring mainly on sites likely to experience changes in land-use which would threaten the survival of the plant in the wild; or, taxa whose total population is so small that the likelihood of recovery from disturbance, including localised natural events such as drought, fire or landslip, is doubtful.
r - Rare in Victoria: rare but not considered otherwise threatened - there are relatively few known populations or the taxon is restricted to a relatively small area.
k - Poorly Known in Victoria: poorly known and suspected, but not definitely known, to belong to one of the above categories (x, e, v or r) within Victoria. At present, accurate distribution information is inadequate.

Appendix 1.2 – Defining Ecological Significance

Table A1.2. Criteria for defining Ecological Significance ratings for significant flora, fauna and communities.

National Significance
Flora: National conservation status is based on the EPBC Act list of taxa considered threatened in Australia (i.e. extinct, critically endangered, endangered, vulnerable).
Fauna: National conservation status is based on the EPBC Act list of taxa considered threatened in Australia (i.e. Extinct, Critically Endangered, Endangered, Vulnerable). Fauna listed as Extinct, Critically Endangered, Endangered, Vulnerable, or Rare under National Action Plans for terrestrial taxon prepared for DoE: mammals (Woinarski *et al.* 2014), bats (Duncan *et al.* 1999), birds (Garnett *et al.* 2011), reptiles (Cogger *et al.* 1993), amphibians (Tyler 1997) and butterflies (Sands and New 2002).
Communities: Vegetation communities considered critically endangered, endangered or vulnerable under the EPBC Act and considering vegetation condition.
State Significance
Flora: Threatened taxa listed under the provisions of the FFG Act. Flora listed in the State Government's Advisory List of Rare or Threatened Plants in Victoria (DEPI 2014).
Fauna: Threatened taxon listed under Schedule 2 of the FFG Act. Fauna listed as Extinct, Critically Endangered, Endangered and Vulnerable on the State Government's Advisory List of Threatened Vertebrate Fauna in Victoria (DSE 2013). Listed as Lower Risk (Near Threatened, Conservation Dependent or Least concern) or Data Deficient under National Action Plans for terrestrial species prepared for the DoE: mammals (Woinarski *et al.* 2014), bats (Duncan *et al.* 1999), birds (Garnett *et al.* 2011), reptiles (Cogger *et al.* 1993), amphibians (Tyler 1997) and butterflies (Sands and New 2002).
Communities: Ecological communities listed as threatened under the FFG Act (DELWP 2021h). EVC listed as threatened (i.e. endangered, vulnerable) or rare in a Native Vegetation Plan for a particular bioregion and considering vegetation condition.
Regional Significance
Fauna: Fauna with a disjunct distribution, or a small number of documented recorded or naturally rare in the particular Bioregion in which the study area is located. A particular taxon that is has an unusual ecological or biogeographical occurrence or listed as Lower Risk – Near Threatened, Data Deficient or Insufficiently Known on the State Government's Advisory List of Threatened Vertebrate Fauna in Victoria (DSE 2013).
Communities: EVC listed as depleted or least concern in a Native Vegetation Plan for a particular bioregion) and considering vegetation condition. EVC considered rare by the author for a particular bioregion.
Local Significance
Local significance is defined as flora, fauna and ecological communities indigenous to a particular area, which are not considered rare or threatened on a national, state or regional level.

Appendix 1.3 – Defining Site Significance

Table A1.3. Criteria for defining Site Significance ratings.

National Significance
A site is of National significance if: • It regularly supports, or has a high probability of regularly supporting individuals of a taxon listed as 'Critically Endangered' or 'Endangered' under the EPBC Act and/or under National Action Plans for terrestrial taxon prepared for the DoE. • It regularly supports, or has a high probability of supporting, an 'important population' as defined under the EPBC Act of one or more nationally 'vulnerable' flora and fauna taxon. • It is known to support, or has a high probability of supporting taxon listed as 'Vulnerable' under National Action Plans. • It is known to regularly support a large proportion (i.e. greater than 1%) of a population of a taxon listed as 'Conservation Dependent' under the EPBC Act and/or listed as Rare or Lower Risk (near threatened, conservation dependent or least concern) under National Action Plans. • It contains an area, or part thereof designated as 'critical habitat' under the EPBC Act, or if the site is listed under the Register of National Estate compiled by the Australian Heritage Commission. • It is a site which forms part of, or is connected to a larger area(s) of remnant native vegetation or habitat of national conservation significance such as most National Park, and/or a Ramsar Wetland(s).
State Significance
A site is of State significance if: • It occasionally (i.e. every 1 to 5 years) supports, or has suitable habitat to support taxon listed as 'Critically Endangered' or 'Endangered' under the EPBC Act and/or under National Action Plans. • It regularly supports, or has a high probability of regularly supporting (i.e. high habitat quality) taxon listed as 'Vulnerable', 'Near threatened', 'Data Deficient' or 'Insufficiently Known' in Victoria (,DSE 2013; DEPI 2014), or species listed as 'Data Deficient' or 'Insufficiently Known' under National Action Plans. • It contains an area, or part thereof designated as 'critical habitat' under the FFG Act. • It supports, or likely to support a high proportion of any Victorian flora and fauna taxa. • It contains high quality, intact vegetation/habitat supporting a high species richness and diversity in a particular bioregion. • It is a site which forms part of, or connected to a larger area(s) of remnant native vegetation or habitat of state conservation significance such as most State Parks and/or Flora and Fauna Reserves.
Regional Significance
A site is of Regional significance if: • It regularly supports, or has a high probability of regularly supporting regionally significant fauna as defined in Table 1.2. • Is contains a large population (i.e. greater than 1% or 5%) of flora considered rare in any regional Native Vegetation Plan for a particular bioregion. • It supports a fauna population with a disjunct distribution, or a particular taxon that has an unusual ecological or biogeographical occurrence. • It is a site which forms part of, or is connected to a larger area(s) of remnant native vegetation or habitat of regional conservation significance such as most Regional Parks and/or Flora and Fauna Reserves.
Local Significance
Most sites are considered to be of at least local significant for conservation, and in general a site of local significance can be defined as: • An area which supports indigenous flora species and/or a remnant EVC, and habitats used by locally significant fauna species. • An area which currently acts, or has the potential to act as a wildlife corridor linking other areas of higher conservation significance and facilitating fauna movement throughout the landscape.

Appendix 1.4 – Vegetation Condition and Habitat Quality

Table A1.4.1 Defining Vegetation Condition ratings.

Criteria for defining Vegetation Condition
High Quality: Vegetation dominated by a diversity of indigenous species, with defined structures (where appropriate), such as canopy layer, shrub layer, and ground cover, with little or few introduced species present.
Moderate Quality: Vegetation dominated by a diversity of indigenous species, but is lacking some structures, such as canopy layer, shrub layer or ground cover, and/or there is a greater level of introduced flora species present.
Low Quality: Vegetation dominated by introduced species, but supports low levels of indigenous species present, in the canopy, shrub layer or ground cover.

Table A1.4.2 Defining Habitat Quality.

Criteria for defining Habitat Quality
High Quality: • High degree of intactness (i.e. floristically and structurally diverse), containing several important habitat features such as ground debris (logs, rocks, vegetation), mature hollow-bearing trees, and a dense understorey component. • High species richness and diversity (i.e. represented by a large number of species from a range of fauna groups). • High level of foraging and breeding activity, with the site regularly used by native fauna for refuge and cover. • Habitat that has experienced, or is experiencing low levels of disturbance and/or threatening processes (i.e. weed invasion, introduced animals, soil erosion, salinity). • High contribution to a wildlife corridor, and/or connected to a larger area(s) of high quality habitat. • Provides known, or likely habitat for one or more rare or threatened species listed under the EPBC Act, FFG Act, or species considered rare or threatened according to DEPI 2014; DSE 2009 or 2013.
Moderate Quality: • Moderate degree of intactness, containing one or more important habitat features such as ground debris (logs, rocks, vegetation), mature hollow-bearing trees, and a dense understorey component. • Moderate species richness and diversity - represented by a moderate number of species from a range of fauna groups. • Moderate levels of foraging and breeding activity, with the site used by native fauna for refuge and cover. • Habitat that has experienced, or is experiencing moderate levels of disturbance and/or threatening processes. • Moderate contribution to a wildlife corridor, or is connected to area(s) of moderate quality habitat. • Provides potential habitat for a small number of threatened species listed under the EPBC Act, FFG Act, or species considered rare or threatened according to DEPI 2014; DSE 2009 or 2013.
Low Quality: • Low degree of intactness, containing few important habitat features such as ground debris (logs, rocks, vegetation), mature hollow-bearing trees, and a dense understorey component. • Low species richness and diversity (i.e. represented by a small number of species from a range of fauna groups). • Low levels of foraging and breeding activity, with the site used by native fauna for refuge and cover. • Habitat that has experienced, or is experiencing high levels of disturbance and/or threatening processes. • Unlikely to form part of a wildlife corridor, and is not connected to another area(s) of habitat. • Unlikely to provide habitat for rare or threatened species listed under the EPBC Act, FFG Act, or considered rare or threatened according to DEPI 2014; DSE 2009 or 2013.

Appendix 1.5 – *Flora and Fauna Guarantee Act 1988* Protected Species

Protected flora and fauna under the *Flora and Fauna Guarantee Act 1988* (FFG Act) are defined as those that have legal protection under the Act. Protected taxa, includes plants and animals from three sources:

- plant or animal taxa (species, subspecies or varieties) listed as threatened under the FFG Act;
- plant taxa belonging to communities listed as threatened under the FFG Act; and,
- plant taxa which are not threatened but require protection for other reasons.

Note that representative plants of a given community are protected as well as the community itself (for example scattered Wallaby-grass *Rytidosperma* spp. are protected in degraded areas previously supporting the listed Western [Basalt] Plains Grassland Community.

Table A1.6 provides a list of plant groups protected under the FFG Act. For threatened plant species likely to occur within the study area refer to Appendix and for listed communities (or representative species) likely to occur within the study area refer to Section 3.4.

Table A1.6. Plant groups (Families, Genera and Kingdom Divisions) protected under the FFG Act (DELWP 2016).

Family/Genera	Common Name	Exclusions
Pteridophyta	Clubmosses, ferns and fern allies	Austral Bracken Pteridium esculentum
Asteraceae	Daisies	N/A
Ericaceae (formerly Epacridaceae)	Heaths	N/A
Orchidaceae	Orchids	N/A
Acacia	Wattles	Acacia dealbata, Acacia decurrens, Acacia implexa, Acacia melanoxylon and Acacia paradoxa
Baeckea	Baeckeas	N/A
Boronia	Boronias	N/A
Calytrix	Fringe-myrtles	N/A
Correa	Correas	N/A
Darwinia	Darwinias	N/A
Eremophila	Emu-bushes	N/A
Eriostemon	Wax-flowers	N/A
Gompholobium	Wedge-peas	N/A
Grevillea	Grevilleas	N/A
Prostanthera	Mint-bushes	N/A
Sphagnum	Sphagnum mosses	N/A
Stylidium	Trigger-plants	N/A
Thryptomene	Thryptomenes	N/A
Thysanotus	Fringe-lilies	N/A
Xanthorrhoea	Grass-trees	N/A

APPENDIX 2 - FLORA

Appendix 2.1 – Flora Results

Legend:

I

e/v/r Listed as endangered/vulnerable/rare in Victoria under the Advisory List of Rare or Threatened Plants in Victoria (DEPI 2014);

***** Listed as a noxious weed under the CaLP Act;

w Weed of National Significance;

- Not applicable

Table A2.1. Flora recorded within the study area.

Scientific Name	Common Name	Comment
NATIVE		
Acacia dealbata	Silver Wattle	-
Acacia mearnsii	Black Wattle	-
Acacia paradoxa	Hedge Wattle	-
Acaena echinata	Sheep's Burr	-
Allocasuarina verticillata	Drooping Sheoak	-
Atriplex semibaccata	Berry Saltbush	-
Austrostipa rudis subsp. *rudis*	Veined Spear-grass	-
Bolboschoenus caldwellii	Salt Club-sedge	-
Bolboschoenus medianus	Marsh Club-sedge	-

Scientific Name	Common Name	Comment
Bursaria spinosa	Sweet Bursaria	-
Chloris truncata	Windmill Grass	-
Correa glabra var. glabra	Rock Correa	-
Convolvulus angustissimus	Australian Bindweed	-
Dodonaea viscosa	Sticky Hop-bush	-
Erodium spp.	Heron's Bill	-
Eucalyptus camaldulensis	River Red-gum	-
Eucalyptus viminalis	Manna Gum	-
Exocarpos strictus	Pale-fruit Ballart	-
Gahnia filum	Chaffy Saw-sedge	-
Juncus spp.	Rush	-
Lachnagrostis filiformis	Blown Grass	-
Leptospermum lanigerum	Woolly Tea-tree	-
Lythrum hyssopifolia	Small Loosestrife	-
Melicytus dentatus	Tree Violet	-
Persicaria decipiens	Slender Knotweed	-
Poa labillardierei	Common Tussock-grass	-
Puccinellia perlaxa	Plains Saltmarsh-grass	-
Rhagodia parabolica	Fragrant Saltbush	r
Rytidosperma carphoides	Short Wallaby-grass	-
Rytidosperma racemosum var. racemosum	Slender Wallaby-grass	-
Rytidosperma spp.	Wallaby-grass	-
Solanum laciniatum	Large Kangaroo Apple	-

Scientific Name	Common Name	Comment
Themeda triandra	Kangaroo Grass	-
Thyridia repens	Monkey-flower	-
Typha australis	Common Reed	-
Walwhalleya proluta	Rigid Panic	-
INTRODUCED OR PLANTED		
Acacia iteaphylla	Flinders Range Wattle	-
Acacia mollifolia	Velvet Wattle	-
Allium vineale	Crow Garlic	-
Arctotheca calendula	Cape weed	-
Avena barbata	Bearded Oat	-
Brassica spp.	Turnip	-
Bromus catharticus	Prairie Grass	-
Bromus diandrus	Great Brome	-
Bromus hordeaceus subsp. hordeaceus	Soft Brome	-
Cirsium vulgare	Spear Thistle	*
Cynodon dactylon	Couch	-
Cortaderia selloana	Pampas Grass	-
Cotula coronopifolia	Water Buttons	-
Dactylis glomerata	Cocksfoot	-
Echium plantagineum	Paterson's Curse	*
Eucalyptus gomphocephala	Tuart	-
Fumaria muralis subsp. muralis	Wall Fumitory	-
Fumaria spp.	Fumitory	-

Scientific Name	Common Name	Comment
Galenia pubescens var. pubescens	Galenia	-
Hakea laurina	Pincushion Hakea	-
Helminthotheca echioides	Ox-tongue	-
Holcus lanatus	Yorkshire Fog	-
Hypericum perforatum subsp. veronense	St John's Wort	-
Hypochaeris radicata	Flatweed	-
Juncus acutus	Spiny rush	*
Lolium spp.	Rye-grass	-
Lycium ferocissimum	African Boxthorn	*w
Malva parviflora	Small-flower Mallow	-
Marrubium vulgare	Horehound	*
Medicago polymorpha	Burr Medic	-
Medicago sativa subsp. sativa	Lucerne	-
Nassella neesiana	Chilean Needle-grass	*w
Nassella trichotoma	Serrated Tussock	*w
Oxalis pes-caprae	Soursob	-
Paspalum dilatatum	Paspalum	-
Phalaris aquatica	Toowoomba Canary-grass	-
Pinus pinaster	Pine	-
Plantago bellardii	Silky Plantain	-
Plantago lanceolata	Ribwort	-
Polygonum aviculare s.l.	Prostrate Knotweed	-
Puccinellia fasciculata	Borrer's Saltmarsh-grass	-

Scientific Name	Common Name	Comment
Rumex crispus	Curled Dock	-
Salvia verbenaca	Wild Sage	-
Sonchus spp.	Sow Thistle	-
Trifolium spp.	Clover	-
Vicia sativa	Common Vetch	-
Vulpia spp.	Fescue	-

Appendix 2.2 – Significant Flora

Table A2.2.1. Significant flora recorded within 10 kilometres of the study area

Key:			
EPBC	*Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)		
FFG	*Flora and Fauna Guarantee Act 1988* (FFG Act)		
DEPI	Advisory List of Threatened Flora in Victoria (DEPI 2014)		
EX	Extinct	X	Extinct
CR	Critically endangered	e	Endangered
EN	Endangered	v	Vulnerable
VU	Vulnerable	r	Rare
K	Poorly Known (Briggs and Leigh 1996)	k	Poorly Known
#	Records identified from EPBC Act Protected Matters Search Tool.	L	Listed
*	Records identified from the FIS		

Table A2.2.2. Likelihood of occurrence rankings: Habitat characteristics assessment of significant flora species previously recorded within 10 kilometres of the study area, or that may potentially occur within the study area to determine their likelihood of occurrence. The values in this table correspond to Column 8 in Table A1.4.3.

1	Known Occurrence	• Recorded within the study area recently (i.e. within ten years).
2	High Likelihood	• Previous records of the species in the local vicinity; and/or, • The study area contains areas of high-quality habitat.
3	Moderate Likelihood	• Limited previous records of the species in the local vicinity; and/or • The study area contains poor or limited habitat.

4	Low Likelihood	• Poor or limited habitat for the species, however other evidence (such as lack of records or environmental factors) indicates there is a very low likelihood of presence.
5	Unlikely	• No suitable habitat and/or outside the species range.

Table A2.2.3. Significant Flora Assessment

Scientific name	Common name	Total # of documented records	Last documented record	EPBC	FFG	DEPI	Study Area*	Likelihood of occurrence^
NATIONAL SIGNIFICANCE								
Amphibromus fluitans	River Swamp Wallaby-grass	#	-	VU	-	-	NW	4
Caladenia pumila	Dwarf Spider-orchid	2	1926	CR	L	e	NW	4
Dianella amoena	Matted Flax-lily	13	2014	EN	L	e	NW	3
Diuris basaltica	Small Golden Moths	1	1998	EN	L	v	NW	4
Dodonaea procumbens	Trailing Hop-bush	#	-	VU	-	v	NW	4
Euphrasia collina subsp. muelleri	Purple Eyebright	2	1853	EN	L	e	NW	4
Glycine latrobeana	Clover Glycine	1	1881	VU	L	v	NW	3
Lachnagrostis adamsonii	Adamson's Blown-grass	9	2002	EN	L	v	NW	2
Lepidium hyssopifolium	Basalt Peppercress	#	-	EN	L	e	NW	3
Leucochrysum albicans subsp. tricolor	White Sunray	1	1853	EN	L	e	N	4
Leucochrysum albicans var. tricolor	Hoary Sunray	#	-	EN	-	e	NW	4
Pimelea spinescens subsp. pubiflora	Wimmera Rice-flower	#	-	CR	L	e	N	4
Pimelea spinescens subsp. spinescens	Spiny Rice-flower	183	2014	CR	L	e	NW	3
Prasophyllum frenchii	Maroon Leek-orchid	#	-	EN	L	e	W	4

Scientific name	Common name	Total # of documented records	Last documented record	EPBC	FFG	DEPI	Study Area*	Likelihood of occurrence^
Prasophyllum spicatum	Dense Leek-orchid	6	1934	VU	-	e	N	4
Prasophyllum suaveolens	Fragrant Leek-orchid	1	1924	EN	L	e	N	4
Pterostylis chlorogramma	Green-striped Greenhood	#	-	VU	L	v	NW	4
Pterostylis cucullata	Leafy Greenhood	#	-	VU	L	e	NW	4
Rutidosis leptorhynchoides	Button Wrinklewort	15	2010	EN	L	e	NW	3
Senecio macrocarpus	Large-headed Fireweed	33	2011	VU	L	e	NW	3
Senecio psilocarpus	Swamp Fireweed	#	-	VU	-	v	W	4
Thelymitra epipactoides	Metallic Sun-orchid	#	-	EN	L	e	NW	4
Thelymitra matthewsii	Spiral Sun-orchid	#	-	VU	L	v	W	4
Xerochrysum palustre	Swamp Everlasting	#	-	VU	L	v	NW	4
STATE SIGNIFICANCE								
Acacia boormanii	Snowy River Wattle	1	2002	-	-	r	N	4
Acacia cupularis	Cup Wattle	1	1983	-	-	r	W	4
Acacia rupicola	Rock Wattle	1	1984	-	-	r	W	4
Acacia uncifolia	Coast Wirilda	4	1884	-	-	r	W	4
Adriana quadripartita	Coast Bitter-bush	2	1885	-	-	v	W	4
Allocasuarina luehmannii	Buloke	3	2007	-	L	e	N	4
Amyema pendula subsp. longifolia	Drooping Mistletoe	1	2002	-	-	r	N	4
Asplenium subglandulosum (glandular form)	Glandular Blanket-fern	2	1770	-	-	k	NW	4
Atriplex paludosa subsp. paludosa	Marsh Saltbush	8	1994	-	-	r	NW	4
Avicennia marina subsp. australasica	Grey Mangrove	3	2003	-	-	r	NW	5
Brachyscome cuneifolia	Wedge-leaf Daisy	1	2002	-	-	k	N	4

Scientific name	Common name	Total # of documented records	Last documented record	EPBC	FFG	DEPI	Study Area*	Likelihood of occurrence^
Callitriche palustris var. palustris	Swamp Water-starwort	1	1986	-	-	k	NW	4
Callitriche umbonata	Winged Water-starwort	1	1770	-	X	r	W	4
Calotis anthemoides	Cut-leaf Burr-daisy	6	1998	-	L	-	NW	4
Cardamine tenuifolia	Slender Bitter-cress	1	1986	-	-	p	NW	4
Comesperma polygaloides	Small Milkwort	14	2011	-	L	v	N	3
Convolvulus angustissimus subsp. omnigracilis	Slender Bindweed	4	2014	-	-	k	NW	2
Correa alba var. pannosa	Velvet White Correa	1	1889	-	-	r	W	4
Corymbia maculata	Spotted Gum	2	2019	-	-	v	N	4
Cullen parvum	Small Scurf-pea	5	2001	-	L	e	NW	3
Diuris palustris	Swamp Diuris	6	1971		L	v	N	3
Dianella sp. aff. longifolia (Benambra)	Arching Flax-lily	5	2011	-	-	v	N	3
Diuris palustris	Swamp Diuris	6	1971	-	L	v	N	4
Epacris rhombifolia	Mountain Coral Heath	1	2005	-	-	r	NW	5
Eucalyptus goniocalyx subsp. laxa	Gum-barked Bundy	1	2004	-	-	v	N	4
Eucalyptus leucoxylon subsp. bellarinensis	Bellarine Yellow-gum	1	1988	-	L	e	W	4
Eucalyptus leucoxylon subsp. connata	Melbourne Yellow-gum	4	2011	-	X	v	NW	3
Eucalyptus sideroxylon subsp. sideroxylon	Mugga	1	2015	-	-	r	NW	4
Euphrasia scabra	Rough Eyebright	1	1770	-	L	e		4
Galium compactum	Compact Bedstraw	1	1885	-	-	r	W	4
Gratiola pedunculata	Stalked Brooklime	1	1980	-	-	k	N	4
Grevillea chrysophaea	Golden Grevillea	1	1770	-	-	r	N	4
Grevillea rosmarinifolia	Rosemary Grevillea	3	1967	-	-	p	NW	4

Scientific name	Common name	Total # of documented records	Last documented record	EPBC	FFG	DEPI	Study Area*	Likelihood of occurrence^
Grevillea rosmarinifolia subsp. glabella	Smooth Grevillea	1	1980	-	-	r	N	4
Grevillea steiglitziana	Brisbane Range Grevillea	1	1770	-	-	r	N	4
Halophila australis	Oval Sea-wrack	1	2014	-	-	k	N	5
Halophila australis	Paddle Weed	1	2014	-	-	k		5
Heterozostera tasmanica	Tasman Grass-wrack	1	2005	-	-	r	NW	5
Heterozostera tasmanica	Eelgrass	2	2005	-	-	r		5
Lachnagrostis robusta	Salt Blown-grass	2	1997	-	-	r	NW	4
Lepidosperma canescens	Hoary Rapier-sedge	1	2007	-	-	r	NW	4
Leptorhynchos elongatus	Lanky Buttons	1	1770	-	-	e	N	4
Lobelia beaugleholei	Showy Lobelia	1	1980	-	-	r	N	4
Maireana aphylla	Leafless Bluebush	3	1992	-	-	k	NW	1
Melaleuca armillaris subsp. armillaris	Giant Honey-myrtle	1	2010	-	-	r	NW	4
Nicotiana maritima	Coast Tobacco	1	1986	-	-	e	NW	4
Nicotiana suaveolens	Austral Tobacco	12	2012	-	-	r	N	3
Olearia pannosa subsp. cardiophylla	Velvet Daisy-bush	1	1977	-	L	v	N	4
Pleurosorus subglandulosus	Glandular Blanket-fern	1	1770	-	-	k	NW	4
Poa billardierei	Coast Fescue	1	1885	-	-	r	W	4
Podolepis linearifolia	Basalt Podolepis	2	1923	-	-	e	W	4
Pomaderris halmaturina subsp. continentis	Glenelg Pomaderris	1	1883	-	-	r	NW	4
Potamogeton australiensis	Thin Pondweed	1	1923	-	-	k	N	4
Prasophyllum lindleyanum	Green Leek-orchid	1	1893	-	X	v	W	4
Prostanthera nivea var. nivea	Snowy Mint-bush	12	2012	-	-	r	NW	4

Scientific name	Common name	Total # of documented records	Last documented record	EPBC	FFG	DEPI	Study Area*	Likelihood of occurrence^
Pterostylis truncata	Brittle Greenhood	206	2014	-	L	e	N	4
Rhagodia parabolica	Fragrant Saltbush	16	2014	-	-	r	NW	3
Rumex crystallinus s.s.	Glistening Dock	1	1982	-	-	v	N	4
Ruppia tuberosa	Tuberous Seatassel	1	2000	-	-	k	N	5
Rytidosperma monticola	Small-flower Wallaby-grass	1	2008	-	-	r	N	4
Rytidosperma richardsonii	Straw Wallaby-grass	1	1961	-	-	v	N	4
Salsola tragus subsp. pontica	Coast Saltwort	4	2005	-	-	r	NW	4
Senecio cunninghamii var. cunninghamii	Branching Groundsel	1	1770	-	-	r	N	4
Swainsona behriana	Southern Swainson-pea	2	1926	-	-	r	N	4
Thelymitra circumsepta	Naked Sun-orchid	1	1770	-	-	v	NW	4
Thelymitra gregaria	Basalt Sun-orchid	1	1925	-	L	e	N	4
Triodia bunicola	Southern Porcupine Grass	1	1770	-	-	k	NW	4
Tripogonella loliiformis	Rye Beetle-grass	4	1998	-	-	r	NW	3

Data source: Victorian Biodiversity Atlas (DELWP 2021a); Protected Matters Search Tool (DAWE 2021a).Taxonomic order: Alphabetical. *: N = NGGA, W = WGGA; NW = NGGA and WGGA; ^ Likelihood of occurrence post-survey effort.

Appendix 2.3 – Habitat Hectare Assessment

Table A2.3. Condition Scores recorded during the field assessment.

Vegetation Zone		PG1	PG2	FRW1	FRW2	CGW1
Bioregion		VVP	VVP	VVP	VVP	VVP
EVC / Tree		PG(LR)	PG(LR)	FRW	FRW	CGW
EVC Number		132_63	132_63	56	56	68
EVC Conservation Status		En	En	En	En	En
Patch Condition	Large Old Trees /10	0	0	10	0	0
	Canopy Cover /5	0	0	5	0	0
	Under storey /25	5	5	5	5	5
	Lack of Weeds /15	2	6	6	2	6
	Recruitment /10	3	3	3	0	0
	Organic Matter /5	2	4	4	4	4
	Logs /5	0	0	2	0	0
	Treeless EVC Multiplier	1.36	1.36	1.00	1.00	1.00
	Subtotal =	16.32	24.48	35.00	11.00	15.00
Landscape Value /25		3	3	3	3	3
Habitat Points /100		19	27	38	13	18
Habitat Score		**0.19**	**0.27**	**0.38**	**0.13**	**0.18**

Notes: VVP = Victorian Volcanic Plain bioregion; Vu = Vulnerable; En = Endangered; CGW = Creekline Grassy Woodland; PG = Plains Grassland; FRW= Floodplain Riparian Woodland.

Appendix 2.4 – Scattered Trees and Large Trees in Patches

Table A2.4.1. Scattered Trees and Large Trees in the NGGA

Tree ID *	Species Name	Common Name	Type	DBH	Size Class
1	*Eucalyptus microcarpa*	Grey Box	Scattered	75	Small
2	*Eucalyptus microcarpa*	Grey Box	Scattered	73	Small
3	*Eucalyptus microcarpa*	Grey Box	Scattered	84	Large

Note: * Tree ID as shown in Figure 2

Table A2.4.2. Scattered Trees and Large Trees in the WGGA

Tree ID *	Species Name	Common Name	DBH	Size Class	Type	Notes
1	River Red-gum	*Eucalyptus camaldulensis*	115	Large	Patch	
2	River Red-gum	*Eucalyptus camaldulensis*	118	Large	Patch	
3	River Red-gum	*Eucalyptus camaldulensis*	84	Large	Patch	
4	River Red-gum	*Eucalyptus camaldulensis*	83	Large	Patch	
5	River Red-gum	*Eucalyptus camaldulensis*	116	Large	Patch	
6	River Red-gum	*Eucalyptus camaldulensis*	107	Large	Patch	
7	River Red-gum	*Eucalyptus camaldulensis*	102	Large	Patch	
8	River Red-gum	*Eucalyptus camaldulensis*	116	Large	Patch	
9	River Red-gum	*Eucalyptus camaldulensis*	91	Large	Patch	
10	River Red-gum	*Eucalyptus camaldulensis*	84	Large	Patch	
11	River Red-gum	*Eucalyptus camaldulensis*	80	Large	Patch	
12	River Red-gum	*Eucalyptus camaldulensis*	96	Large	Patch	
13	River Red-gum	*Eucalyptus camaldulensis*	147	Large	Patch	Hollows

Tree ID *	Species Name	Common Name	DBH	Size Class	Type	Notes
14	River Red-gum	*Eucalyptus camaldulensis*	94	Large	Patch	
15	River Red-gum	*Eucalyptus camaldulensis*	128	Large	Patch	
16	River Red-gum	*Eucalyptus camaldulensis*	178	Large	Patch	Hollows
17	River Red-gum	*Eucalyptus camaldulensis*	200	Large	Patch	Hollows
18	River Red-gum	*Eucalyptus camaldulensis*	184	Large	Scattered	Hollows
19	River Red-gum	*Eucalyptus camaldulensis*	106	Large	Patch	
20	River Red-gum	*Eucalyptus camaldulensis*	114	Large	Patch	
21	River Red-gum	*Eucalyptus camaldulensis*	85	Large	Patch	
22	River Red-gum	*Eucalyptus camaldulensis*	109	Large	Patch	
23	River Red-gum	*Eucalyptus camaldulensis*	123	Large	Patch	
24	River Red-gum	*Eucalyptus camaldulensis*	113	Large	Patch	
25	River Red-gum	*Eucalyptus camaldulensis*	81	Large	Patch	
26	River Red-gum	*Eucalyptus camaldulensis*	119	Large	Patch	
27	River Red-gum	*Eucalyptus camaldulensis*	92	Large	Patch	
28	River Red-gum	*Eucalyptus camaldulensis*	81	Large	Patch	
29	River Red-gum	*Eucalyptus camaldulensis*	84	Large	Patch	
30	River Red-gum	*Eucalyptus camaldulensis*	101	Large	Patch	
31	River Red-gum	*Eucalyptus camaldulensis*	113	Large	Patch	
32	River Red-gum	*Eucalyptus camaldulensis*	86	Large	Patch	
33	River Red-gum	*Eucalyptus camaldulensis*	80	Large	Patch	
34	River Red-gum	*Eucalyptus camaldulensis*	96	Large	Patch	
35	River Red-gum	*Eucalyptus camaldulensis*	84	Large	Patch	
36	River Red-gum	*Eucalyptus camaldulensis*	129	Large	Patch	

Tree ID *	Species Name	Common Name	DBH	Size Class	Type	Notes
37	River Red-gum	*Eucalyptus camaldulensis*	119	Large	Patch	
38	River Red-gum	*Eucalyptus camaldulensis*	101	Large	Patch	
39	River Red-gum	*Eucalyptus camaldulensis*	125	Large	Patch	
40	River Red-gum	*Eucalyptus camaldulensis*	136	Large	Patch	
41	River Red-gum	*Eucalyptus camaldulensis*	165	Large	Patch	
42	River Red-gum	*Eucalyptus camaldulensis*	83	Large	Patch	
43	River Red-gum	*Eucalyptus camaldulensis*	107	Large	Patch	
44	River Red-gum	*Eucalyptus camaldulensis*	83	Large	Patch	
45	River Red-gum	*Eucalyptus camaldulensis*	115	Large	Patch	
46	River Red-gum	*Eucalyptus camaldulensis*	88	Large	Patch	
47	River Red-gum	*Eucalyptus camaldulensis*	85	Large	Patch	
48	Dead Stag		70	Large	Patch	
49	River Red-gum	*Eucalyptus camaldulensis*	92	Large	Patch	
50	River Red-gum	*Eucalyptus camaldulensis*	98	Large	Patch	
51	River Red-gum	*Eucalyptus camaldulensis*	129	Large	Patch	
52	River Red-gum	*Eucalyptus camaldulensis*	92	Large	Patch	
53	River Red-gum	*Eucalyptus camaldulensis*	97	Large	Patch	
54	River Red-gum	*Eucalyptus camaldulensis*	85	Large	Patch	
55	River Red-gum	*Eucalyptus camaldulensis*	157	Large	Patch	
56	River Red-gum	*Eucalyptus camaldulensis*	82	Large	Patch	
57	River Red-gum	*Eucalyptus camaldulensis*	94	Large	Patch	
58	River Red-gum	*Eucalyptus camaldulensis*	134	Large	Patch	
59	River Red-gum	*Eucalyptus camaldulensis*	82	Large	Patch	

Tree ID *	Species Name	Common Name	DBH	Size Class	Type	Notes
60	River Red-gum	*Eucalyptus camaldulensis*	98	Large	Patch	
61	Dead Stag		72	Large	Patch	
62	River Red-gum	*Eucalyptus camaldulensis*	88	Large	Patch	
63	River Red-gum	*Eucalyptus camaldulensis*	98	Large	Patch	
64	River Red-gum	*Eucalyptus camaldulensis*	153	Large	Patch	
65	River Red-gum	*Eucalyptus camaldulensis*	144	Large	Patch	
66	Dead stag		97	Large	Patch	
67	River Red-gum	*Eucalyptus camaldulensis*	131	Large	Patch	
68	River Red-gum	*Eucalyptus camaldulensis*	130	Large	Patch	
69	River Red-gum	*Eucalyptus camaldulensis*	235	Large	Patch	
70	River Red-gum	*Eucalyptus camaldulensis*	183	Large	Patch	
71	River Red-gum	*Eucalyptus camaldulensis*	81	Large	Patch	
72	River Red-gum	*Eucalyptus camaldulensis*	80	Large	Patch	
73	River Red-gum	*Eucalyptus camaldulensis*	123	Large	Patch	
74	River Red-gum	*Eucalyptus camaldulensis*	110	Large	Patch	
75	River Red-gum	*Eucalyptus camaldulensis*	120	Large	Patch	
76	River Red-gum	*Eucalyptus camaldulensis*	148	Large	Patch	Hollows
77	River Red-gum	*Eucalyptus camaldulensis*	156	Large	Patch	
78	River Red-gum	*Eucalyptus camaldulensis*	102	Large	Patch	
79	River Red Gum	*Eucalyptus camaldulensis*	105	Large	Scattered	
80	River Red Gum	*Eucalyptus camaldulensis*	96	Large	Patch	
81	River Red Gum	*Eucalyptus camaldulensis*	104	Large	Patch	
82	River Red Gum	*Eucalyptus camaldulensis*	86	Large	Patch	

Tree ID *	Species Name	Common Name	DBH	Size Class	Type	Notes
83	River Red Gum	*Eucalyptus camaldulensis*	88	Large	Patch	
84	River Red Gum	*Eucalyptus camaldulensis*	95	Large	Patch	
85	River Red Gum	*Eucalyptus camaldulensis*	105	Large	Patch	
86	River Red Gum	*Eucalyptus camaldulensis*	99	Large	Patch	
87	River Red Gum	*Eucalyptus camaldulensis*	102	Large	Patch	
88	River Red Gum	*Eucalyptus camaldulensis*	98	Large	Patch	
89	River Red Gum	*Eucalyptus camaldulensis*	135	Large	Patch	
90	River Red Gum	*Eucalyptus camaldulensis*	147	Large	Patch	
91	River Red Gum	*Eucalyptus camaldulensis*	108	Large	Patch	
92	River Red Gum	*Eucalyptus camaldulensis*	122	Large	Patch	
93	River Red Gum	*Eucalyptus camaldulensis*	80	Large	Patch	
94	River Red Gum	*Eucalyptus camaldulensis*	86	Large	Patch	
95	River Red Gum	*Eucalyptus camaldulensis*	89	Large	Patch	
96	River Red Gum	*Eucalyptus camaldulensis*	92	Large	Patch	
97	River Red Gum	*Eucalyptus camaldulensis*	92	Large	Patch	
98	River Red Gum	*Eucalyptus camaldulensis*	126	Large	Patch	
99	River Red Gum	*Eucalyptus camaldulensis*	138	Large	Patch	
100	River Red Gum	*Eucalyptus camaldulensis*	107	Large	Patch	
101	River Red Gum	*Eucalyptus camaldulensis*	88	Large	Patch	
102	River Red Gum	*Eucalyptus camaldulensis*	89	Large	Patch	
103	River Red Gum	*Eucalyptus camaldulensis*	108	Large	Patch	
104	River Red Gum	*Eucalyptus camaldulensis*	82	Large	Patch	

Note. * Tree ID as shown in Figure 3a and 3b

Appendix 2.5. Summary of Spiny Rice-Flower Targeted Survey Results

Table A2.5. Summary of survey results and resources used for targeted Spiny Rice-flower surveys.

Date	Study Area	Survey Address	# Person Days	# SRF Recorded
23/07/2020	NGGA	460 Evans Rd	4	0
27/07/2020	NGGA	Roadside patches	4	0
29/07/2020	NGGA	460 Evans Rd	6	0
30/07/2020	NGGA	350 Emmerson Road	4	0
4/08/2020	WGGA	68 Bridge Street Batesford, 205 Ballan Road Moorabool	3	0
5/08/2020	WGGA	68 Bridge Street Batesford, 205 Ballan Road Moorabool	5	0
6/08/2020	NGGA	165 Staceys Road; 515 Elcho Road	6	0
10/08/2020	NGGA/ WGGA	135 Staceys Rd; 35 Staceys Rd	6	0
11/08/2020	NGGA/ WGGA	135 Staceys Rd; 35 Staceys Rd	6	0
12/08/2020	NGGA	405 Elcho Road	4	0
13/08/2020	NGGA	295 Elcho Road	4	0
14/08/2020	NGGA	400 Elcho Road;	4	0
17/08/2020	NGGA	350 Elcho Road, 435 Elcho Road	4	0
18/08/2020	NGGA	165 Staceys Road; 450 Elcho Road	6	0
19/08/2020	NGGA	235 Staceys Rd; 195 Staceys Rd,	6	0
20/08/2020	NGGA	550 Elcho Rd, 500 Elcho Rd	5	0
21/08/2020	WGGA	35-55 Ballan Rd,	5	0
25/08/2020	WGGA	60 Avonlea Rd, 110 Creamery Rd	5	0
27/08/2020	NGGA	350 Elcho Road, 475 Elcho Road	5	0

APPENDIX 3 - FAUNA

Appendix 3.1 – Fauna Results

Table A3.1. Fauna species recorded during the ecological survey.

Common Name	Scientific Name	Native / Introduced
Mammals		
Black Rat	*Rattus rattus*	Introduced
Brushtail Possum	*Trichosurus vulpecula*	Native
Common Ringtail Possum	*Pseudocheirus peregrinus*	Native
European Hare	*Lepus europaeus*	Introduced
European Rabbit	*Oryctolagus cuniculus*	Introduced
Eastern Grey Kangaroo	*Macropus giganteus*	Native
House Mouse	*Mus musculus*	Introduced
Platypus *	*Ornithorhynchus anatinus*	Native
Red Fox	*Vulpes vulpes*	Introduced
Birds		
Australasian Pipit	*Anthus novaeseelandiae*	Native
Australian Magpie	*Gymnorhina tibicen*	Native
Australian White Ibis	*Threskiornis moluccus*	Native
Australasian Swamphen	*Porphyrio melanotus*	Native
Black-shouldered Kite	*Elanus axillaris*	Native
Banded Lapwing	*Vanellus tricolor*	Native
Brown Falcon	*Falco berigora*	Native

Common Name	Scientific Name	Native / Introduced
Brown Goshawk	*Accipiter fasciatus*	Native
Cattle Egret	*Ardea ibis*	Native
Collared Sparrowhawk	*Accipiter cirrhocephalus*	Native
Common Myna	*Acridotheres tristis*	Introduced
Common Starling	*Sturnus vulgaris*	Introduced
Darter	*Anhinga novaehollandiae*	Native
Dusky Woodswallow	*Artamus cyanopterus*	Native
Eastern Great Egret	*Ardea modesta*	Native
Eurasian Coot	*Fulica atra*	Native
European Goldfinch	*fam. Fringillidae gen. Carduelis*	Introduced
European Skylark	*Alauda arvensis*	Introduced
Galah	*Eolophus roseicapilla*	Native
Grey Teal	*Anas gracilis*	Native
House Sparrow	*Passer domesticus*	Introduced
Little Raven	*Corvus mellori*	Native
Magpie-lark	*Grallina cyanoleuca*	Native
Masked Lapwing	*Vanellus miles*	Native
Nankeen Kestrel	*Falco cenchroides*	Native
Pacific Black Duck	*Anas superciliosa*	Native
Red-rumped Parrot	*Psephotus haematonotus*	Native
Red Wattlebird	*Anthochaera carunculata*	Native
Southern Boobook	*Ninox novaeseelandiae*	Native
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*	Native
Straw-necked Ibis	*Threskiornis spinicollis*	Native

Common Name	Scientific Name	Native / Introduced
Striated Thornbill	*Acanthiza lineata*	Native
Sulphur-crested Cockatoo	*Cacatua galerita*	Native
Tawny Frogmouth	*Podargus strigoides*	Native
Wedge-tailed Eagle	*Aquila audax*	Native
Welcome Swallow	*Hirundo neoxena*	Native
White-browed Woodswallow	*Artamus superciliosus*	Native
White-faced heron	*Egretta novaehollandiae*	Native
White-necked Heron	*Ardea pacifica*	Native
Whistling kite	*Haliastur sphenurus*	Native
Willie Wagtail	*Rhipidura leucophrys*	Native
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	Native
Reptiles		
Brown Snake	*Pseudonaja textilis*	Native
Common Blue-tongued Lizard	*Tiliqua scincoides scincoides*	Native
Eastern Blue-tongue Lizard	*Tiliqua scincoides*	Native
Eastern long-necked turtle	*Chelodina longicollis*	Native
Garden Skink	*Lampropholis guichenoti*	Native
Marbled Gecko	*Christinus marmoratus*	Native
Striped Legless Lizard	*Delma impar*	Native
Frogs		
Common Froglet	*Crinia signifera*	Native
Eastern Banjo Frog	*Limnodynastes dumerilii*	Native
Eastern Froglet	*Crinia signifera*	Native
Growling Grass Frog	*Litoria raniformis*	Native

Common Name	Scientific Name	Native / Introduced
Spotted Marsh Frog	*Limnodynastes tasmaniensis*	Native
Invertebrates		
Common Yabby	*Cherax destructor*	Native
Golden Sun Moth	*Synemon plana*	Native
Fish		
Australian Smelt	*Retropinna semoni*	Native
Brown Trout	*Salmo trutta*	Introduced
Common Carp	*Cyprinus carpio*	Introduced
Common Galaxias	*Galaxias maculatus*	Native
Flat-headed Gudgeon	*Philypnodon grandiceps*	Native
Freshwater Shrimp	*Paratya australiensis*	Native
Mosquito Fish	*Gambusia holbrookii*	Introduced
River Blackfish	*Gadopsis marmoratus*	Native
Short-finned Eel	*Anguilla australis*	Native
Southern Pygmy Perch	*Nannoperca australis*	Native
Tupong	*Pseudaphritis urvilli*	Native

Note: * Active Platypus burrow identified – no Platypus observed.

Appendix 3.2 – Significant Fauna Species

Table A3.2. Significant fauna within 10 kilometres of the NGGA study area.

Habitat characteristics of significant fauna species previously recorded within 10 kilometres of the study area, or that may potentially occur within the study area were assessed to determine their likelihood of occurrence. The likelihood of occurrence rankings for each of the threatened species are:

1	High Likelihood	• Known resident in the study area based on site observations, database records, or expert advice; and/or, • Recent records (i.e. within five years) of the species in the local area (VBA 2011); and/or, • The study area contains the species' preferred habitat.
2	Moderate Likelihood	• The species is likely to visit the study area regularly (i.e. at least seasonally); and/or, • Previous records of the species in the local area (DEWLP 2021d); and/or, • The study area contains some characteristics of the species' preferred habitat.
3	Low Likelihood	• The species is likely to visit the study area occasionally or opportunistically whilst en route to more suitable sites; and/or, • There are only limited or historical records of the species in the local area (i.e. more than 20 years old); and/or, • The study area contains few or no characteristics of the species' preferred habitat.
4	Unlikely	• No previous records of the species in the local area; and/or, • The species may fly over the study area when moving between areas of more suitable habitat; and/or, • Out of the species' range; and/or, • No suitable habitat present.

EPBC	*Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
FFG	*Flora and Fauna Guarantee Act 1988* (FFG Act)
DSE	Advisory List of Threatened Vertebrate Fauna in Victoria (DSE 2013); Advisory List of Threatened Invertebrate Fauna in Victoria (DSE 2009)
NAP	National Action Plan (Cogger et al 1993; Duncan et al. 1999; Garnet and Crowley 2000; Lee 1995; Maxwell et al. 1996; Sands and New 2002; Tyler 1997)

EX	Extinct
RX	Regionally extinct
CR	Critically endangered
EN	Endangered
VU	Vulnerable
RA	Rare
NT	Near threatened
CD	Conservation dependent
LC	least concern

DD	Data deficient (insufficiently or poorly known
L	Listed as threatened under FFG Act
I	Invalid or ineligible for listing under the FFG Act
#	Listed on the Protected Matters Search Tool
*	Additional information from the Victorian Fauna Database

Common Name	Scientific Name	Last Documented Record (VBA)	# Records (VBA)	EPBC Act	FFG ACT	DSE (2013)	Study Area *	Likelihood of Occurrence^
NATIONAL SIGNIFICANCE								
Antipodean Albatross	*Diomedea exulans antipodensis*	#	-	VU	-	-	-	4
Australasian Bittern	*Botaurus poiciloptilus*	1990	3	EN	L	EN	NW	4
Australian Grayling	*Prototroctes maraena*	1998	46	VU	L	VU	W	2
Australian Painted Snipe	*Rostratula australis*	1956	2	VU	L	CR	W	3
Black-browed Albatross	*Thalassarche melanophris melanophris*	#	-	VU	-	VU	W	4
Buller's Albatross	*Thalassarche bulleri*	#	-	VU	L	-	-	4
Campbell Albatross	*Thalassarche melanophris impavida*	#	-	VU	-	-	-	4
Curlew Sandpiper	*Calidris ferruginea*	2008	55	CR	-	EN	NW	3
Little Galaxias	*Galaxiella toourtkoourt*	#	-	VU	L	EN	W	2
Eastern Barred Bandicoot	*Perameles gunnii*	1977	15	EN	L	WX	NW	4
Eastern Curlew	*Numenius madagascariensis*	2000	33	CR	-	VU	NW	4
Fairy Prion	*Pachyptila turtur*	1981	2	VU	-	VU	NW	4
Fairy Tern	*Sternula nereis nereis*	2016	51	VU	L	EN	NW	4
Golden Sun Moth	*Synemon plana*	2016	31	CR	L	CR	N	1
Gould's Petrel	*Pterodroma leucoptera*	#	-	EN	-	-	W	4
Grassland Earless Dragon	*Tympanocryptis pinguicolla*	#	-	EN	L	CR	N	4
Great Knot	*Calidris tenuirostris*	1987	3	CR	L	EN	NW	4
Greater Sand Plover	*Charadrius leschenaultii*	#	-	VU	-	CR	W	4
Green Turtle	*Chelonia mydas*	#	-	VU	-	-	-	4
Grey Falcon	*Falco hypoleucos*	#	-	VU	L	EN	NW	3
Grey-headed Albatross	*Thalassarche chrysostoma*	#	-	EN	L	VU	-	4

Common Name	Scientific Name	Last Documented Record (VBA)	# Records (VBA)	EPBC Act	FFG ACT	DSE (2013)	Study Area *	Likelihood of Occurrence^
Grey-headed Flying-fox	*Pteropus poliocephalus*	2018	21	VU	L	VU	NW	3
Growling Grass Frog	*Litoria raniformis*	2010	16	VU	L	EN	W	1
Hooded Plover	*Thinornis rubricollis rubricollis*	#	-	VU	L	VU	-	4
Humpback Whale	*Megaptera novaeangliae*	#	-	VU	L	VU	-	4
Indian Yellow-nosed Albatross	*Thalassarche carteri*	1979	1	VU	L	VU	-	4
Leathery Turtle	*Dermochelys coriacea*	2017	1	EN	L	CR	-	4
Lesser Sand Plover	*Charadrius mongolus*	1988	4	EN	-	CR	-	4
Loggerhead Turtle	*Caretta caretta*	#	-	EN	-	-	-	4
Macquarie Perch	*Macquaria australasica*	1981	6	EN	L	EN	W	3
Murray Cod	*Maccullochella peelii*	1873	1	VU	L	VU	W	4
Northern Buller's Albatross	*Thalassarche bulleri platei*	#	-	VU	-	-	-	4
Northern Giant-Petrel	*Macronectes halli*	#	-	VU	L	NT	-	4
Northern Royal Albatross	*Diomedea epomophora sanfordi*	#	-	EN	-	-	-	4
Northern Siberian Bar-tailed Godwit	*Limosa lapponica menzbieri*	#	-	EN	-	-	-	4
Orange-bellied Parrot	*Neophema chrysogaster*	1993	5	CR	L	CR	NW	4
Painted Honeyeater	*Grantiella picta*	2015	9	VU	L	VU	NW	4
Pink-tailed Worm-Lizard	*Aprasia parapulchella*	#	-	VU	L	EN	N	4
Plains-wanderer	*Pedionomus torquatus*	#	-	CR	L	CR	W	4
Red Knot	*Calidris canutus*	2018	23	EN	-	EN	NW	3
Regent Honeyeater	*Anthochaera phrygia*	1993	5	CR	L	CR	NW	4
Salvin's Albatross	*Thalassarche salvini*	#	-	VU	-	-	-	4
Shy Albatross	*Thalassarche cauta*	#	-	VU	L	EN	-	4

Common Name	Scientific Name	Last Documented Record (VBA)	# Records (VBA)	EPBC Act	FFG ACT	DSE (2013)	Study Area *	Likelihood of Occurrence^
Sooty Albatross	*Phoebetria fusca*	#	-	VU	L	-	-	4
Southern Brown Bandicoot	*Isoodon obesulus obesulus*	1964	1	EN	L	NT	-	4
Southern Elephant Seal	*Mirounga leonina*	2005	10	VU	-	-	-	4
Southern Giant-Petrel	*Macronectes giganteus*	#	-	EN	L	VU	-	4
Southern Right Whale	*Eubalaena australis*	#	-	EN	L	CR	-	4
Southern Royal Albatross	*Diomedea epomophora epomophora*	#	-	VU	-	-	-	4
Spot-tailed Quoll	*Dasyurus maculatus maculatus*	#	-	EN	L	EN	NW	4
Striped Legless Lizard	*Delma impar*	1992	2	VU	L	EN	N	1
Swamp Antechinus	*Antechinus minimus maritimus*	#	-	VU	L	NT	W	4
Swift Parrot	*Lathamus discolor*	2019	78	CR	L	EN	NW	3
Wandering Albatross	*Diomedea exulans*	1959	3	VU	L	EN	-	4
Western Alaskan Bar-tailed Godwit	*Limosa lapponica baueri*	#	-	VU	-	-	-	4
Yarra Pygmy Perch	*Nannoperca obscura*	2009	4	VU	L	VU	-	3
STATE SIGNIFICANCE								
Australian Bustard	*Ardeotis australis*	1890	1	-	L	CR	W	4
Baillon's Crake	*Porzana pusilla palustris*	2010	11	-	L	VU	NW	3
Barking Owl	*Ninox connivens connivens*	1969	1	-	L	EN	NW	4
Black Falcon	*Falco subniger*	2019	88	-	-	VU	NW	2
Blue-billed Duck	*Oxyura australis*	2019	102	-	L	EN	NW	3
Brolga	*Grus rubicunda*	2012	4	-	L	VU	NW	3
Brown Toadlet	*Pseudophryne bibronii*	1977	23	-	L	EN	N	3
Bush Stone-curlew	*Burhinus grallarius*	1961	3	-	L	EN	N	4

Common Name	Scientific Name	Last Documented Record (VBA)	# Records (VBA)	EPBC Act	FFG ACT	DSE (2013)	Study Area *	Likelihood of Occurrence^
Caspian Tern	*Hydroprogne caspia*	2019	94	-	L	NT	NW	3
Chestnut-rumped Heathwren	*Calamanthus pyrrhopygius*	1969	4	-	L	VU	N	4
Diamond Dove	*Geopelia cuneata*	1977	1	-	L	NT	NW	4
Diamond Firetail	*Stagonopleura guttata*	2016	139	-	L	NT	NW	3
Eastern Great Egret	*Ardea modesta*	2014	140	-	L	VU	NW	3
Freckled Duck	*Stictonetta naevosa*	2019	90	-	L	EN	NW	3
Grey Goshawk	*Accipiter novaehollandiae novaehollandiae*	2007	23	-	L	VU	NW	2
Grey Plover	*Pluvialis squatarola*	2017	6	-	-	EN	NW	3
Grey-crowned Babbler	*Pomatostomus temporalis temporalis*	1923	2	-	L	EN	NW	3
Grey-tailed Tattler	*Tringa brevipes*	2015	38	-	L	CR	NW	3
Hardhead	*Aythya australis*	2019	738	-	-	VU	NW	2
Hooded Robin	*Melanodryas cucullata cucullata*	1971	2	-	L	NT	NW	3
Intermediate Egret	*Ardea intermedia*	2001	11	-	L	EN	NW	3
Lewin's Rail	*Lewinia pectoralis pectoralis*	2006	6	-	L	VU	NW	3
Little Bittern	*Ixobrychus minutus dubius*	1970	1	-	L	EN	NW	3
Little Egret	*Egretta garzetta nigripes*	2013	123	-	L	EN	NW	2
Little Tern	*Sternula albifrons sinensis*	1992	13	-	L	VU	NW	3
Magpie Goose	*Anseranas semipalmata*	2019	922	-	L	NT	NW	3
Major Mitchell's Cockatoo	*Lophocroa leadbeateri*	1999	2	-	L	VU	NW	3
Marsh Sandpiper	*Tringa stagnatilis*	2016	165	-	-	VU	NW	3
Masked Owl	*Tyto novaehollandiae novaehollandiae*	1984	2	-	L	EN	N	3
Musk Duck	*Biziura lobata*	2019	191	-	-	VU	NW	3

Common Name	Scientific Name	Last Documented Record (VBA)	# Records (VBA)	EPBC Act	FFG ACT	DSE (2013)	Study Area *	Likelihood of Occurrence^
Platypus	*Ornithorhynchus anatinus*	2019	9	-	L	VU	W	1
Powerful Owl	*Ninox strenua*	1987	5	-	L	VU	NW	3
Sea-cucumber species	*Thyone nigra*	1960	1	-	L	VU	-	4
Speckled Warbler	*Chthonicola sagittatus*	1976	5	-	L	VU	NW	3
Square-tailed Kite	*Lophoictinia isura*	2018	2	-	L	VU	NW	3
Terek Sandpiper	*Xenus cinereus*	2017	6	-	L	EN	NW	4
Tussock Skink	*Pseudemoia pagenstecheri*	2016	1	-	-	VU	NW	2
Whimbrel	*Numenius phaeopus*	1978	2	-	-	VU	NW	4
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	2019	39	-	L	VU	NW	3
White-faced Storm-Petrel	*Pelagodroma marina*	2016	1	-	-	VU	NW	4
White-throated Needletail	*Hirundapus caudacutus*	2019	37	-	-	VU	NW	3
Wood Sandpiper	*Tringa glareola*	2008	2	-	-	VU	NW	4
REGIONAL SIGNIFICANCE								
Australasian Shoveler	*Anas rhynchotis*	1979	8	-	-	VU	NW	2
Azure Kingfisher	*Alcedo azurea*	1999	4	-	-	NT	NW	4
Black-eared Cuckoo	*Chrysococcyx osculans*	2018	27	-	-	NT	N	3
Black-faced Cormorant	*Phalacrocorax fuscescens*	2019	8	-	-	NT	NW	4
Black-tailed Godwit	*Limosa limosa*	2011	2	-	-	VU	NW	4
Brown Treecreeper (south-eastern ssp.)	*Climacteris picumnus victoriae*	2004	11	-	-	NT	NW	3
Common Diving-Petrel	*Pelecanoides urinatrix*	1978	2	-	-	NT	NW	4
Common Dunnart	*Sminthopsis murina murina*	1964	2	-	-	VU	NW	4
Common Greenshank	*Tringa nebularia*	2014	72	-	-	VU	NW	4

Common Name	Scientific Name	Last Documented Record (VBA)	# Records (VBA)	EPBC Act	FFG ACT	DSE (2013)	Study Area *	Likelihood of Occurrence^
Common Sandpiper	*Actitis hypoleucos*	2007	5	-	-	VU	NW	4
Elegant Parrot	*Neophema elegans*	1993	1	-	-	VU	N	4
Emu	*Dromaius novaehollandiae*	2019	431	-	-	NT	N	4
Fat-tailed Dunnart	*Sminthopsis crassicaudata*	2015	3	-	-	NT	NW	3
Glossy Ibis	*Plegadis falcinellus*	2019	8	-	-	NT	NW	3
Grey Plover	*Pluvialis squatarola*	1979	3	-	-	EN	NW	4
Latham's Snipe	*Gallinago hardwickii*	2019	401	-	-	NT	NW	3
Little Button-quail	*Turnix velox*	1977	3	-	-	NT	NW	3
Long-toed Stint	*Calidris subminuta*	2015	8	-	-	NT	NW	4
Marsh Sandpiper	*Tringa stagnatilis*	2011	29	-	-	VU	NW	4
Nankeen Night Heron	*Nycticorax caledonicus hillii*	2010	64	-	-	NT	NW	3
Pacific Golden Plover	*Pluvialis fulva*	1999	15	-	-	VU	NW	4
Pacific Gull	*Larus pacificus pacificus*	2014	136	-	-	NT	NW	4
Pectoral Sandpiper	*Calidris melanotos*	2018	11	-	-	NT	NW	4
Pied Cormorant	*Phalacrocorax varius*	2019	538	-	-	NT	NW	4
Red-backed Kingfisher	*Todiramphus pyrropygia pyrropygia*	2008	2	-	-	NT	N	4
Royal Spoonbill	*Platalea regia*	2019	689	-	-	NT	NW	3
Ruddy Turnstone	*Arenaria interpres*	2000	7	-	-	VU	NW	4
Sanderling	*Calidris alba*	2017	6	-	-	NT	NW	4
Sooty Oystercatcher	*Haematopus fuliginosus*	2019	33	-	-	NT	NW	4
Spotted Harrier	*Circus assimilis*	2019	155	-	-	NT	NW	1
Spotted Quail-thrush	*Cinclosoma punctatum*	1976	2	-	-	NT	NW	4

Common Name	Scientific Name	Last Documented Record (VBA)	# Records (VBA)	EPBC Act	FFG ACT	DSE (2013)	Study Area *	Likelihood of Occurrence^
Whimbrel	*Numenius phaeopus*	1977	1	-	-	VU	NW	4
Whiskered Tern	*Chlidonias hybridus javanicus*	2014	41	-	-	NT	NW	3
White-faced Storm-Petrel	*Pelagodroma marina*	1924	1	-	-	VU	NW	4
White-throated Needletail	*Hirundapus caudacutus*	2000	15	-	-	VU	NW	2
White-winged Black Tern	*Chlidonias leucopterus*	2019	7	-	-	NT	NW	4
Wood Sandpiper	*Tringa glareola*	2008	2	-	-	VU	NW	4

Data source: Victorian Biodiversity Atlas (DELWP 2021a); Protected Matters Search Tool (DAWE 2021a). *: N = NGGA, W = WGGA; NW = NGGA and WGGA; ^ Likelihood of occurrence post-survey effort. Taxonomic order: Mammals (Strahan 1995 *in* Menkhorst and Knight 2004); Birds (Christidis and Boles, 2008); Reptiles and Amphibians (Cogger *et al.* 1983 *in* Cogger 1996); Fish (Nelson 1994).

Appendix 3.3 – Fauna Species Detected during Targeted Australian Grayling Surveys along the Moorabool River



Plate 46. Short-finned Eel detected within the Moorabool River (Ecology and Heritage Partners Pty Ltd 12/12/2019).



Plate 47. Australian Smelt detected within the Moorabool River (Ecology and Heritage Partners Pty Ltd 12/12/2019).



Plate 48. Flat-headed Gudgeon detected within the Moorabool River (Ecology and Heritage Partners Pty Ltd 12/12/2019



Plate 49. Common Galaxias detected within the Moorabool River (Ecology and Heritage Partners Pty Ltd 12/12/2019).



Plate 50. Common Carp within the Moorabool River (Ecology and Heritage Partners Pty Ltd 12/12/2019).



Plate 51. River Blackfish detected within the Moorabool River (Ecology and Heritage Partners Pty Ltd 12/12/2019).



Plate 52. Active Platypus burrow within the Moorabool River (Ecology and Heritage Partners Pty Ltd 12/12/2019).



Plate 53. Tupong detected within the Moorabool River (Ecology and Heritage Partners Pty Ltd 12/12/2019).



Plate 54. Southern Pygmy Perch detected within the Moorabool River (Ecology and Heritage Partners Pty Ltd 12/12/2019).

APPENDIX 4 – FAUNA SURVEY DATA

Appendix 4.1 – Striped Legless Lizard Survey Data 2020/2021 – NGGA

Note: GS = Garden Skink, BS = Brown Snake; MG = Marbled Gecko; HM = House Mouse; BTL = Blue Tongue Lizard; SMF = Spotted Marsh Frog;

Table A4.1.1. Survey data and weather conditions for the Striped Legless Lizard Tile Checks – NGGA

	2020 Date	Time	Grid #	Temp (°C)	Wind	Humidity	Above Tile Temp C°	Below Tile Temp	Soil Temp C°	SLL	Other Species
Wk 1	30/09	10:32	28	16.8	NNE (22)	79%	20.5	16.1	15	-	
	30/09	9:35	29	16.3	NNE (22)	79%	20.8	15.2	15	-	
	30/09	12:15	30	17.1	NNW (20)	72%	22	16.7	16	-	
	30/09	11:50	31	17.1	NNW (20)	72%	26.5	18.5	17	-	
	30/09	12:45	32	17.1	NNW (20)	72%	20.5	16.5	16	-	
	30/09	12:30	33	17.1	NNW (20)	72%	25.3	19.8	15	-	
	30/09	12:06	34	17.1	NNW (20)	72%	26.3	20.5	15	-	
	30/09	13:34	35	18	NNW (22)	68%	27.3	19	15	-	
	30/09	12:00	36	17	NNW (20)	72%	26.5	19.1	15	-	
	30/09	14:03	37	18	NNW (20)	72%	26.4	18.8	16	-	
	30/09	14:19	38	19	NNW (20)	72%	24.3	21.3	17	-	BTL
	29/09	9:10	39	13.1	NNE (13)	92%	19.6	15.8	15	-	
	29/09	9:28	40	13.3	NNE (13)	92%	19.4	15.9	15	-	
	29/09	9:41	41	14	NNE (13)	92%	19	15.3	15	-	
	29/09	9:55	42	14.3	NNE (13)	92%	20.2	16.4	16	-	
	29/09	10:10	43	14.7	NNE (10)	92%	21.8	16.4	16	-	SMF
	29/09	10:27	44	15.8	NNE (10)	92%	20.1	16.6	16	-	
	29/09	10:40	45	16.1	NNE (10)	92%	23.6	17.2	16	-	
	29/09	10:51	46	16.5	NNE (7)	81%	23.6	17.9	16	-	
	29/09	11:03	47	17	NNE (7)	81%	25.4	18.6	17	-	
	29/09	11:17	48	17.5	NNE (7)	81%	26.7	18.8	17	-	
			49								
			50								
			51								
			52								
			53								

	2020 Date	Time	Grid #	Temp (°C)	Wind	Humidity	Above Tile Temp C°	Below Tile Temp	Soil Temp C°	SLL	Other Species
			54								
	29/09	12:06	55	19.1	NNE (7)	52%	28.6	17.6	18	-	
	29/09	12:20	56	19.6	NNE (7)	52%	29.1	18.1	18	-	
	29/09	12:37	57	19.8	NNE (7)	52%	29.4	17.9	18	-	
	29/09	13:43	58	21	NNE (7)	52%	34.2	16.7	18	-	
	29/09	13:30	59	21	NNE (7)	52%	33.3	19.9	20	-	
	29/09	13:45	60	21	NNE (7)	52%	33.1	21.9	20	-	
	29/09	14:06	61	21	NNE (7)	52%	35.7	22.8	18	-	
	01/10	10:00	62	15	WNW (20)	X	14.3	9.8	13	-	
	01/10	10:15	63	15	WNW (20)	X	15.9	11.4	13	-	
	01/10	10:30	64	16	WNW (22)	X	32.7	16.9	13	1	1xGS
	01/10	11:05	65	16	WNW (22)	X	26.2	16.2	16	-	
	01/10	11:30	66	17	WNW (22)	X	26	18.2	14	-	
	01/10	11:40	67	17	WNW (22)	X	22.3	16.1	14	-	
	01/10	11:49	68	17	WNW (22)	X	27.9	16.1	14	-	
	01/10	11:57	69	18	WNW (22)	X	24.4	19.8	15	-	
	01/10	12:10	70	18	WNW (22)	X	36.6	20.1	15	-	
	29/09	12:37	71	21	NNE (7)	52%	33.4	19.5	15	-	
	29/09	12:23	72	21	NNE (7)	52%	33	17	14	-	
			73								
			74								
			75								
	01/10	13:10	76	18	WNW (22)	X	32.8	21.1	21	2	2 x GS, HM
	01/10	13:25	77	18	WNW (22)	X	17.9	15.9	17	-	
Wk 2	07/10	9:07	28	12	ESE (11)	X	13.1	12.2	13	-	
	07/10	9:00	29	12	ESE (11)	X	12.1	11.5	13	-	
	08/10	12:25	30	13	ESE (11)	X	17.5	15.8	15	-	
	07/10	10:47	31	13	ESE (11)	X	21	17	14	-	
	07/10	11:30	32	13	ESE (11)	X	20.5	16.4	14	-	
	07/10	11:10	33	13	ESE (11)	X	22	17.5	14	-	
	07/10	12:00	34	13	ESE (11)	X	19	15.7	14	-	
	07/10	12:43	35	13	ESE (11)	X	20	16.7	14	-	BTL, SMF
	07/10	13:09	36	13	ESE (11)	X	19.8	17.1	14	-	
	07/10	12:37	37	13	ESE (11)	X	19.8	16.9	16	-	

	2020 Date	Time	Grid #	Temp (°C)	Wind	Humidity	Above Tile Temp C°	Below Tile Temp	Soil Temp C°	SLL	Other Species
	07/10	12:50	38	13	ESE (11)	X	19.3	16.5	16	-	BTL
	06/10	9:50	39	10.9	S (28)	X	11.2	9.6	14	-	BTL
	06/10	10:15	40	11	S (28)	X	12.4	9.3	13	-	
	06/10	10:13	41	11	S (28)	X	14.7	13.5	13	-	
	06/10	10:43	42	11.4	SSE (26)	X	17	10.4	15	-	
	06/10	11:00	43	11.4	S (22)	X	17.4	14.8	14	-	BTL
	06/10	11:40	44	11.4	SSE (26)	X	16	8.5	14	-	
	06/10	11:30	45	11.4	SSE (26)	X	15.3	10	13	-	
	06/10	12:00	46	11.4	SSE (26)	X	16.6	10	13	-	BTL
	06/10	12:15	47	11.4	SSE (26)	X	16.1	11.5	13	-	
	06/10	12:30	48	11.4	SSE (26)	X	17.2	10.4	14	-	
	06/10	11:00	49	13	SSE (26)	X	16.2	15.5	X	-	BS
	06/10	11:20	50	13	SSE (26)	X	16.2	10.9	X	-	SMF, GS
	06/10	11:35	51	10	SSE (26)	X	12.2	10.1	X	-	SMF
	06/10	10:30	52	13	SSE (26)	X	15.3	11.5	X	2	GS
	06/10	10:20	53	13	SSE (26)	X	12.7	8.7	X	-	
	06/10	10:00	54	13	SSE (26)	X	12.5	10.2	X	-	2 x Blue Tounge Lizard
	06/10	9:30	55	13	SSE (26)	X	10.9	9.5	X	-	
	06/10	12:20	56	13	SSE (24)	X	15.2	11.5	X	-	Blue Tounge Lizard
	06/10	12:40	57	13	SSE (24)	X	17	14.6	X	-	
	07/10	10:45	58	13.1	NE (6)	X	19.3	13.7	15	-	
	07/10	10:30	59	13.1	NE (6)	X	22.6	16.6	15	-	
	07/10	10:44	60	13.3	NE (6)	X	22.7	17.6	15	-	
	07/10	11:10	61	12.9	NE (6)	X	23.2	19.1	15	-	
			62								
			63								
			64								
			65								
			66								
			67								
			68								
			69								

	2020 Date	Time	Grid #	Temp (°C)	Wind	Humidity	Above Tile Temp C°	Below Tile Temp	Soil Temp C°	SLL	Other Species
			70								
	07/10	12:00	71	13.2	NE (6)	X	21.3	17.6	16	-	
	07/10	11:45	72	13.2	NE (6)	X	23.2	19.1	15	-	
	06/10	13:30	73	13	SSE (24)	X	18	14.2	X	-	
	06/10	14:15	74	13	SSE (24)	X	18.3	14.3	X	-	
	06/10	13:55	75	13	SSE (24)	X	20.2	18.5	X	-	
			76								
			77								
Wk 3	14/10	10:40	28	13.7	NE (7)	X	20.6	17.3	16	-	
	14/10	10:20	29	13.7	NE (7)	X	18.3	15.5	16	-	
	14/10	11:50	30	14	ENE (5)	X	22	12	17	-	
	14/10	11:30	31	14	ENE (5)	X	23	20.6	17	-	
	14/10	13:22	32	16	NE (5)	X	46	35	20	-	
	14/10	12:57	33	16	NE (5)	X	40.8	26	19	-	
	14/10	12:20	34	16	ENE (13)	X	33	25.5	17	-	
	14/10	14:48	35	19	SW (4)	X	44	37	19	-	
	14/10	15:00	36	19	SW (4)	X	42.8	28.2	22	-	HM
	14/10	15:16	37	19	SW (4)	X	44	27.9	22	-	
	14/10	14:27	38	19	SW (4)	X	50	34	20	-	
	12/10	16:40	39	22	NE (9)	50%	36.2	31.5	20	-	BTL
	12/10	16:25	40	22	NE (11)	51%	40	32.9	21	-	
	12/10	15:59	41	22	NE (11)	51%	38.9	30.8	25	-	
	12/10	16:15	42	22	NE (11)	51%	39.7	28.2	24	-	
	12/10	15:00	43	22	NE (11)	51%	47.5	24.2	25	-	
	12/10	14:46	44	21	NE (9)	50%	46	36.9	26	-	
	12/10	14:36	45	21	NE (9)	50%	47.3	32.1	23	-	
	12/10	15:19	46	22	NE (11)	51%	41.2	27.6	23	-	
	12/10	15:25	47	22	NE (11)	51%	43.8	30.9	23	-	
	12/10	15:40	48	22	NE (9)	51%	40.7	29.4	24	-	
	12/10	11:51	49	16	NNE (11)	64%	34	21	17	-	
	12/10	12:01	50	16	NNE (11)	64%	32.8	21	17	-	
	12/10	12:12	51	17	NNE (11)	64%	30.7	21.1	18	-	
	12/10	12:27	52	17	NNE (11)	64%	37.4	21.2	19	2	
	12/10	12:50	53	18	NNE (11)	60%	43.4	37.7	19	-	

	2020 Date	Time	Grid #	Temp (°C)	Wind	Humidity	Above Tile Temp C°	Below Tile Temp	Soil Temp C°	SLL	Other Species
	12/10	13:05	54	19	NNE (9)	57%	42.4	24.4	18	2	4xGS, BTL
	12/10	11:02	55	14	NE (12)	100%	28.2	19.9	15	-	
	12/10	11:15	56	15	NE (12)	100%	31.2	24.7	16	-	
	12/10	11:35	57	16	NE (12)	100%	35.3	21.7	17	-	
	13/10	14:00	58	16	SE (17)	69%	31	16	20	-	
	13/10	14:10	59	16	SE (17)	69%	36	20.7	20	-	
	13/10	14:26	60	16	SE (17)	69%	36.9	23.1	20	-	
	13/10	14:15	61	16	SE (17)	69%	43	17.5	20	-	
	15/10	10:35	62	21	SSW (5)	X	16.6	15.7	17	-	
	15/10	11:10	63	18.6	SW (9)	X	18	16.3	18	-	1xGS
	15/10	11:25	64	18.9	SW (7)	X	20.2	17.6	18	2	1xGS
	15/10	11:57	65	18.9	SW (7)	X	22.9	18.1	18	-	
	15/10	12:10	66	20.1	NE (4)	X	22.4	16.9	18	-	
	15/10	12:23	67	20.1	NE (4)	X	22.7	19.7	18	-	
	15/10	12:00	68	20.1	NE (4)	X	22.2	19	19	-	
	15/10	11:45	69	18.9	SW (7)	X	19	17.5	18	-	
	15/10	12:10	70	20.1	NE (4)	X	22.2	19	19	-	
	13/10	14:50	71	16	SE (17)	69%	41	17	18	-	
	13/10	14:30	72	16	SE (17)	69%	36	17	18	-	
	12/10	10:05	73	13	WNW (10)	94%	19.2	13.7	13	-	
	12/10	10:18	74	14	N (11)	96%	17.4	14.1	13	-	
	12/10	9:30	75	13	WNW (10)	92%	15.5	14.7	12	-	HM
	15/10	8:47	76	20.8	N (31)	X	19.6	17.5	17	-	
	15/10	8:58	77	20.8	N (31)	X	18.3	16.6	18	1	
Wk 4	21/10	12:45	28	17	SE (13)	66%	31.9	22.6	18	-	
	21/10	12:55	29	17	SE (13)	66%	43	36.7	19	-	
	21/10	13:10	30	17	SE (13)	66%	41.9	31.4	19	-	
	22/10	15:20	31	17	SE (17)	62%	39.3	28	27	-	
	22/10	14:00	32	17	SE (17)	62%	48.8	36.4	20	-	
	22/10	14:20	33	17	SE (17)	62%	47.9	27.7	27	-	
	22/10	14:40	34	17	SE (17)	62%	40.7	32.5	23	-	
	21/10	14:00	35	17	ESE (17)	66%	40.7	30.9	19	-	
	22/10	15:50	36	17	SE (17)	62%	28.2	24.7	22	-	
	21/10	14:15	37	17	ESE (17)	66%	34.7	25.5	21	-	

	2020 Date	Time	Grid #	Temp (°C)	Wind	Humidity	Above Tile Temp C°	Below Tile Temp	Soil Temp C°	SLL	Other Species
	21/10	14:20	38	17	ESE (17)	66%	41.2	35.5	19	-	
	19/10	11:48	39	14	SW (13)	76%	24.9	16.1	17	-	BTL
	19/10	11:40	40	15	SW (17)	75%	22.8	18.8	18	-	
	19/10	11:14	41	15	SW (17)	75%	22.4	18.8	17	-	
	19/10	11:25	42	15	SW (17)	75%	27	18.5	18	-	
	19/10	10:20	43	14	SW (15)	87%	25.6	17.5	19	1	
	19/10	10:05	44	14	SW (15)	87%	24.2	17.5	17	-	
	19/10	9:50	45	14	SW (15)	87%	19.2	14.2	17	-	
	19/10	10:35	46	14	SW (15)	87%	21.9	14	19	-	
	19/10	10:45	47	14	SW (15)	87%	23.3	14.1	17	-	
	19/10	10:58	48	15	SW (17)	75%	20.1	13.2	19	-	
	19/10	12:45	49	13.2	S (19)	85%	27.8	20.1	16	-	
	19/10	13:00	50	13.2	S (19)	85%	26.6	19.8	16	-	
	19/10	13:18	51	13.4	S (19)	85%	22.5	19.1	17	-	
	19/10	15:28	52	13.2	S (19)	85%	24.4	18.9	20	-	
	19/10	15:35	53	13.2	S (19)	85%	24.9	22.8	19	-	
	19/10	15:45	54	13.2	S (19)	85%	24.8	21.7	19	-	
	19/10	11:35	55	14.3	SW (15)	76%	22.5	17.6	16	-	
	19/10	11:50	56	14.3	SW (15)	76%	22.8	19.1	15	-	
	19/10	12:10	57	14.3	SW (15)	76%	22.7	17.3	15	-	
	20/10	13:37	58	17	ESE (9)	X	31.3	24.5	18	-	
	20/10	12:15	59	17	ESE (9)	X	27.1	19.5	18	-	
	20/10	12:29	60	17	ESE (9)	X	27.9	19.5	18	-	
	20/10	12:44	61	17	ESE (9)	X	28.3	19.9	17	-	
	22/10	9:00	62	13.8	SE (11)	80%	15.6	13.8	15	-	
	22/10	11:45	63	15	ESE (9)	70%	29.8	20.4	17	-	
	22/10	12:00	64	15	ESE (9)	70%	36.7	23.9	18	-	1xGS
	22/10	9:27	65	13.8	SE (11)	80%	20.7	15	16	-	
	22/10	9:46	66	14.9	ESE (13)	74%	25.6	20.8	17	1	
	22/10	10:00	67	14.9	ESE (13)	74%	22.8	17.6	17	-	
	22/10	10:30	68	14.9	ESE (13)	74%	34.1	27.1	17	-	
	22/10	11:04	69	15	ESE (9)	70%	30.3	20.7	16	-	
	22/10	11:23	70	15	ESE (9)	70%	36.4	18	16	1	
	20/10	12:50	71	17	ESE (9)	X	32.3	24.5	18	-	

	2020 Date	Time	Grid #	Temp (°C)	Wind	Humidity	Above Tile Temp C°	Below Tile Temp	Soil Temp C°	SLL	Other Species
	20/10	13:47	72	17	ESE (9)	X	34.2	27.9	17	-	
	19/10	10:20	73	13.8	SW (15)	87%	25	16	14	-	
	19/10	10:35	74	13.8	SW (15)	87%	24	16	14	-	
	19/10	10:00	75	13.8	SW (15)	87%	20	14	14	-	
	22/10	12:25	76	16	ESE (13)	70%	36.7	25.3	19	-	
	22/10	12:40	77	16	ESE (13)	70%	48.8	36.4	20	1	BS
Wk 5	28/10	13:00	28	19	ESE (7)	X	43	28.9	20	-	
	28/10	12:25	29	17	SW (4)	X	47.9	36.5	22	-	
	28/10	11:50	30	17	ESE (9)	X	43	31.3	17	-	
	28/10	11:37	31	17	SE (5)	X	30.4	21.1	19	-	
	28/10	9:30	32	15	ESE (27)	X	21.6	18.7	16	-	
	28/10	10:00	33	15	ESE (27)	X	25.1	22.1	16	-	
	28/10	10:24	34	15	ESE (27)	X	26.3	23.2	16	-	
	28/10	10:45	35	15	ESE (27)	X	23.7	17.9	16	-	
	28/10	11:00	36	17	ENE (11)	X	35.6	22.1	17	-	HM
	28/10	14:35	37	20	ESE (11)	X	45.5	38.7	23	-	
	28/10	14:15	38	20	ESE (11)	X	48.2	39.4	21	-	
	26/10	15:00	39	16.3	ESE (41)	52%	33.8	20.1	16	-	2xBTL
	26/10	15:20	40	16.3	ESE (41)	52%	34.1	18.8	15	-	
	27/10	11:24	41	13.8	ESE (34)	X	19.5	15.3	15	-	
	27/10	11:36	42	13.8	ESE (34)	X	18.1	14.8	15	-	
	27/10	11:50	43	13.9	ESE (34)	X	18.7	15.1	15	-	
	27/10	12:03	44	14.2	ESE (34)	X	19.6	15	15	-	
	27/10	12:18	45	14.4	ESE (34)	X	20.8	14.7	15	-	
	27/10	12:33	46	14.4	ESE (34)	X	20.9	16.1	15	-	
	27/10	12:45	47	14.9	ESE (34)	X	20.8	15.2	15	-	
	27/10	12:57	48	15	ESE (34)	X	22.7	15.9	15	-	
	26/10	12:00	49	14.5	SE (35)	57%	21.9	19.6	16	-	
	26/10	12:10	50	14.5	SE (35)	57%	22.5	20.1	16	-	
	26/10	12:20	51	14.5	SE (35)	57%	21.7	17.7	16	-	
	26/10	12:35	52	14.5	SE (35)	57%	25	17	16	1	BS, Snake Skin
	26/10	12:55	53	14.5	SE (35)	57%	30.7	20.7	16	-	
	26/10	13:10	54	14.5	SE (35)	57%	32.4	23.8	16	2	BTL, BS
	26/10	11:00	55	14.5	SE (35)	57%	19.2	15.5	14	-	

	2020 Date	Time	Grid #	Temp (°C)	Wind	Humidity	Above Tile Temp C°	Below Tile Temp	Soil Temp C°	SLL	Other Species
	26/10	11:20	56	14.5	SE (35)	57%	21.1	14.3	14	-	
	26/10	11:40	57	14.5	SE (35)	57%	23.1	13.7	14	-	
	27/10	9:55	58	11	ESE (43)	X	17	13.5	14	-	
	27/10	9:45	59	12.2	ESE (43)	X	16.3	12.3	15	-	
	27/10	10:07	60	12.8	ESE (43)	X	16.5	13.7	15	-	
	27/10	10:21	61	12.8	ESE (43)	X	18.3	14.7	15	-	
	28/10	14:45	62	20	ESE (11)	X	50.6	28.3	24	-	
	28/10	15:00	63	20	ESE (11)	X	44.1	27.8	25	-	
	29/10	14:45	64	20	WSW (9)	X	33.4	21.3	21	**3**	
	29/10	14:30	65	20	WSW (9)	X	32.2	24	22	-	
	29/10	14:10	66	20	WSW (9)	X	29.3	18.6	21	**2**	
	29/10	14:00	67	20	WSW (9)	X	25.2	18.3	20	-	
	29/10	13:44	68	20	WSW (9)	X	34.3	26	21	-	
	29/10	15:00	69	21	WSW (9)	X	30.1	26.9	22	-	1xGS
	29/10	13:45	70	20	WSW (9)	X	51.8	20.5	22	-	
	27/10	10:40	71	15	ESE (41)	X	22.7	15.7	14	-	
	27/10	10:30	72	11	ESE (43)	X	22.8	14.8	13	-	
	26/10	10:30	73	14	SE (35)	61%	21.2	12.5	14	-	
	26/10	10:15	74	14	SE (35)	61%	17.5	11	14	-	
	26/10	9:50	75	14	SE (35)	61%	19.9	1.5	13	-	
	28/10	15:20	76	19	ESE (13)	X	36.6	25.8	24	-	2xGS
	28/10	15:30	77	19	ESE (13)	X	43.3	32.2	22	**3**	2xGS
Wk 6	04/11	14:20	28	15.2	SSW (31)	X	25.8	21.7	21	-	
	04/11	13:50	29	19	WSW (24)	X	23.6	24	22	**1**	
	04/11	10:30	30	20	SW (5)	X	19.1	19.2	20	-	
	04/11	9:30	31	20	NW (20)	X	20.2	20.3	21	-	
	04/11	12:37	32	19	WSW (24)	X	17.3	18.2	25	-	
	04/11	11:00	33	20	SW (5)	X	20.1	19.7	20	-	
	04/11	11:25	34	20	SW (5)	X	18.5	18.8	20	-	
	04/11	11:48	35	19	WSW (24)	X	17.2	16.2	18	-	BTL
	04/11	12:05	36	19	WSW (24)	X	16.8	16.6	19	-	
	04/11	15:00	37	15.2	SSW (28)	X	26.6	21.3	21	-	
	04/11	14:45	38	15.2	SSW (28)	X	27.3	24.7	20	-	BTL
	02/11	12:50	39	18.6	SE (17)	85%	42.9	37.6	24	-	

	2020 Date	Time	Grid #	Temp (°C)	Wind	Humidity	Above Tile Temp C°	Below Tile Temp	Soil Temp C°	SLL	Other Species
	02/11	12:05	40	18.6	SE (17)	85%	60.1	52	29.7	-	
	02/11	11:45	41	17.9	SE (13)	85%	57	44.6	31	-	
	02/11	12:30	42	18.6	SE (17)	85%	53	36	24	-	
	02/11	10:10	43	16.4	NNE (6)	99%	36.2	25.2	25	-	BTL
	02/11	9:45	44	16.4	NNE (6)	99%	39.2	23	22	-	
	02/11	9:30	45	16.4	NNE (6)	99%	30.2	23.6	19	-	BTL
	02/11	10:32	46	16.4	NNE (6)	99%	34	25.2	23	-	BTL
	02/11	11:00	47	17.9	SE (13)	85%	42	34.9	30	-	
	02/11	11:25	48	17.9	SE (13)	85%	50	34	26	-	
	06/11	13:45	49	20	SW (11)	X	24	18	20	-	
	06/11	13:15	50	19	SW (11)	X	25	18.5	21	-	
	06/11	12:35	51	18	SW (11)	X	24	20.7	19	-	
	06/11	12:05	52	18	SW (11)	X	22.6	17.6	20	-	GS, 3xSMF
	06/11	14:30	53	22	SW (11)	X	24.4	17.9	20	-	
	06/11	14:45	54	22	SW (11)	X	24.8	17.5	18	**3**	BTL
	02/11	13:50	55	22.4	ESE (9)	68%	50.3	31.2	30	-	
	02/11	14:20	56	22.4	ESE (9)	68%	54.9	36	28	-	
	02/11	14:50	57	22.4	ESE (9)	68%	55.4	36.3	26	-	
			58								
			59								
			60								
			61								
	05/11	13:37	62	16	SSW (28)	X	19.8	18.8	18	-	
	05/11	15:00	63	13.5	S (13)	X	45.2	28.8	22	-	2xGS
	05/11	13:50	64	14.5	SSW (35)	X	39.1	27.9	20	**1**	
	05/11	14:00	65	13	S (11)	X	40.2	22.3	20	-	
	05/11	14:10	66	13	S (11)	X	49.5	29.4	23	-	
	05/11	14:20	67	12.5	SSE (9)	X	52.5	28.8	22	-	
	05/11	14:30	68	13	SSE (9)	X	46.2	21.2	19	-	
	05/11	14:40	69	13.5	S (13)	X	54.7	19.8	20	-	
	05/11	14:50	70	13.5	S (13)	x	53.4	20.2	21	-	
	04/11	15:30	71	15.2	SSW (28)	X	21	17.6	20	-	
	04/11	15:15	72	15.2	SSW (28)	X	24.6	19.2	20	-	
			73								

	2020 Date	Time	Grid #	Temp (°C)	Wind	Humidity	Above Tile Temp C°	Below Tile Temp	Soil Temp C°	SLL	Other Species
			74								
			75								
	05/11	13:05	76	16	SSW (28)	X	37	24.8	22	-	2xGS, 2x SMF
	05/11	13:15	77	16	SSW (28)	X	31.4	24	20	-	
	11/11	11:00	28	21.3	N (19)	X	17.5	18.2	22	-	
	11/11	11:15	29	21.3	N (19)	X	20.9	19.9	21	-	
	11/11	8:45	30	24.2	NNE (22)	X	20.4	20.3	22	-	
	11/11	8:25	31	24.2	NNE (22)	X	20.6	20.2	22	-	BTL
	11/11	10:15	32	22	NE (11)	X	21.2	19.3	21	-	
	11/11	9:05	33	24.2	NNE (22)	X	20	19.9	21	-	
	11/11	9:40	34	24.2	NNE (22)	X	20.1	20.2	22	-	
	11/11	10:30	35	22	NE (11)	X	19.3	18.7	20	-	
	11/11	10:00	36	22	NE (11)	X	20.7	21.1	21	-	
	11/11	12:35	37	21	NE (4)	X	20.4	19.8	22	-	
	11/11	12:30	38	21	NE (4)	X	20.1	19.2	20	-	
	09/11	12:45	39	21.7	SE (17)	67%	56.1	39.1	31	-	
	09/11	12:20	40	21.7	SE (17)	67%	54.7	38.6	24	-	
	09/11	11:38	41	21.7	SE (17)	67%	60.9	43.4	26	-	
	09/11	12:00	42	21.7	SE (17)	67%	54.4	38.3	27	-	
Wk 7	09/11	10:20	43	20.7	SE (19)	67%	39.5	26.3	28	-	BTL
	09/11	10:00	44	20.7	SE (19)	67%	43.8	25.5	25	-	
	09/11	9:45	45	20.7	SE (19)	67%	42.1	26.7	24	-	BTL, 3xHM
	09/11	10:42	46	20.7	SE (19)	67%	51.1	30.7	25	-	
	09/11	10:58	47	20.7	SE (19)	67%	41.7	30.9	25	-	
	09/11	11:15	48	21.7	SE (17)	67%	55.1	41.8	30	-	
	13/11	8:45	49	15.3	W (22)	76%	17.3	16.7	18	-	
	13/11	9:00	50	15.3	W (22)	76%	19.7	18	18	-	
	13/11	8:30	51	15.3	W (22)	76%	16.5	15.9	18	-	
	13/11	9:50	52	16.7	WNW (19)	68%	24.7	21.3	19	**1**	
	13/11	9:35	53	16.7	WNW (19)	68%	20.3	16.8	18	-	GS
	13/11	9:15	54	15.3	W (22)	76%	23.3	19.1	17	**3**	GS, BS
	13/11	11:40	55	17.3	WNW (20)	65%	28.4	25.5	19	-	
	13/11	11:00	56	17.3	WNW (20)	65%	31	23.1	19	-	
	13/11	11:15	57	17.3	WNW (20)	65%	26.2	21.8	19	-	

	2020 Date	Time	Grid #	Temp (°C)	Wind	Humidity	Above Tile Temp C°	Below Tile Temp	Soil Temp C°	SLL	Other Species
	10/11	9:45	58	27.7	N (26)	X	32.9	28.9	24	-	
	10/11	10:10	59	27.7	N (26)	X	38	22.6	25	-	
	10/11	10:27	60	27.9	N (26)	X	38.9	23.7	25	-	
	10/11	10:42	61	28.2	N (30)	X	42	28	25	-	
	10/11	12:45	62	32.2	NW (30)	X	41.8	30	29	-	
	10/11	13:15	63	32.2	NW (30)	X	42.7	21	29	-	
	10/11	13:25	64	32.2	NW (30)	X	69.9	47.1	40	-	
	10/11	13:40	65	32.2	NW (30)	X	69.7	34.5	39	-	
	10/11	13:55	66	32.2	NW (30)	X	52	34	30	-	
	10/11	14:05	67	33	NW (26)	X	53.2	44	31	-	
	10/11	14:15	68	33	NW (26)	X	56.7	45	34	-	
	10/11	14:25	69	33	NW (26)	X	67.8	44	39	-	
	10/11	14:45	70	33	NW (26)	X	65.9	42	39	-	
	10/11	10:59	71	28.2	N (30)	X	42.5	30.6	28	-	
	10/11	11:15	72	28.2	N (30)	X	53	37.8	29	-	
	11/11	13:10	73	21	NE (4)	X	20.4	19.3	21	-	
	11/11	13:00	74	21	NE (4)	X	20.3	20.2	21	-	
	11/11	13:25	75	21	NE (4)	X	21.2	20.7	21	-	
	10/11	9:00	76	25.8	N (28)	X	31.7	26.4	23	-	
	10/11	9:15	77	25.8	N (28)	X	29.1	22.7	24	-	SMF, 3xGS
Wk 8	18/11	12:15	28	23	ESE (22)	63%	55.3	36.9	28	-	
	18/11	11:40	29	23	ESE (19)	63%	52.9	43.3	27	-	
	18/11	11:05	30	23	NE (20)	63%	50.5	36.1	24	-	
	18/11	10:50	31	23	NE (20)	63%	53.6	35.4	23	-	
	18/11	9:00	32	16.5	NE (15)	63%	27.9	23.2	17	-	
	18/11	9:15	33	16.5	NE (15)	63%	29.4	22.4	19	-	
	18/11	9:35	34	19	NE (11)	63%	24	18.5	18	-	
	18/11	10:00	35	19	NE (11)	63%	28.3	21	19	-	
	18/11	10:15	36	21	NNE (15)	63%	31.3	28	20	-	
	18/11	12:50	37	24	ESE (22)	63%	59.9	40.4	26	-	
	18/11	12:40	38	24	ESE (22)	63%	63.2	37.9	23	-	
			39								
			40								
			41								

	2020 Date	Time	Grid #	Temp (°C)	Wind	Humidity	Above Tile Temp C°	Below Tile Temp	Soil Temp C°	SLL	Other Species
			42								
			43								
			44								
			45								
			46								
			47								
			48								
	20/11	8:50	49	17	W (28)	73%	29.7	24.3	22	-	
	20/11	9:10	50	18	W (28)	67%	30.9	23.3	20	-	
	20/11	8:30	51	17	W (28)	73%	22.1	20.5	20	-	
	20/11	10:10	52	19	SW (22)	62%	37.6	32.1	23	-	
	20/11	9:35	53	19	W (28)	64%	25.6	21.6	22		
	20/11	9:45	54	19	W (28)	64%	26.1	21.5	19	2	
	20/11	11:25	55	21	SSW (17)	66%	42.3	31.9	24	-	
	20/11	11:40	56	21	S (22)	64%	41.2	30.4	23	-	
	20/11	12:00	57	20	S (22)	65%	38.7	29.2	22	-	
			58								
			59								
	20/11	12:24	60	20.3	S (22)	65%	36.5	28.8	22	-	
	20/11	11:05	61	21	SSW (17)	66%	39.1	33.4	23	-	
	17/11	8:45	62	15.3	W (26)	73%	27.3	25.8	17	-	
	17/11	10:25	63	16.9	W (28)	60%	37.5	20.5	20	-	
	17/11	9:05	64	15.3	W (26)	73%	24.3	23	19	1	
	17/11	9:20	65	15.9	WSW (25)	73%	31.2	21.8	19	-	
	17/11	9:30	66	15.9	WSW (25)	73%	20.6	14.2	17	1	GS
	17/11	9:45	67	17	W (32)	73%	36.7	88.9	21	-	
	17/11	9:55	68	17	W (32)	73%	39.1	30.2	19	-	
	17/11	10:05	69	17	W (32)	73%	14.8	13.7	19	-	
	17/11	10:15	70	17	W (32)	73%	28.3	28.6	20	-	
	20/11	10:45	71	21	SW (17)	66%	44.2	32.8	24	-	
	20/11	10:30	72	21	SW (17)	66%	49.9	2.8	23	-	
	18/11	13:35	73	25	ESE (20)	63%	53.1	45.9	26	-	HM
	18/11	13:50	74	25	ESE (20)	63%	53.4	34.8	24	-	
	18/11	14:00	75	25	ESE (20)	63%	55.9	40	30	-	

	2020 Date	Time	Grid #	Temp (°C)	Wind	Humidity	Above Tile Temp C°	Below Tile Temp	Soil Temp C°	SLL	Other Species
			76								
			77								
			28								
			29								
			30								
			31								
			32								
			33								
			34								
			35								
			36								
			37								
			38								
	26/11	13:56	39	20	SSE (20)	58%	55.6	36.2	29	-	HM
	26/11	14:14	40	20	SSE (20)	58%	30.1	35.6	28	-	
			41								
			42								
			43								
Wk 9			44								
			45								
			46								
			47								
			48								
	27/11	9:40	49	17.7	N (9)	79%	32.2	24.2	20	-	
	27/11	9:35	50	16.4	NE (7)	79%	25.2	21.7	20	-	
	27/11	9:55	51	17.7	N (9)	79%	23.2	20.5	21	-	BTL
	27/11	8:50	52	15.4	NNE (7)	79%	22.4	19.5	18	**2**	BS
	27/11	9:05	53	15.4	NNE (7)	79%	30.3	22.3	21	-	
	27/11	9:20	54	16.4	NE (7)	79%	24.3	21.1	19	-	
			55								
			56								
			57								
	23/11	9:00	58	16.3	SSW (17)	97%	22.6	17.9	17	-	
	23/11	9:10	59	16.3	SSW (17)	97%	23.2	16.6	18	-	

	2020 Date	Time	Grid #	Temp (°C)	Wind	Humidity	Above Tile Temp C°	Below Tile Temp	Soil Temp C°	SLL	Other Species
	23/11	9:20	60	16.3	SSW (17)	97%	25.2	16.4	18	-	
	23/11	9:30	61	16.3	SSW (17)	97%	24.6	16.6	18	-	
	25/11	10:10	62	19.2	SW (26)	74%	29.5	21.9	18	-	
	25/11	10:22	63	19.5	SW (26)	74%	29.5	23.4	18	-	
	25/11	10:35	64	21.5	SW (26)	74%	30.1	22.8	18	-	
	25/11	10:48	65	22.1	SW (26)	65%	30.3	22.8	19	-	
	25/11	11:00	66	22.8	SW (26)	65%	30	23.1	19	-	
	25/11	11:18	67	23.5	SW (26)	65%	33.5	20.7	19	-	
	25/11	11:32	68	23.5	SW (26)	50%	31.7	22.6	19	-	
	25/11	11:45	69	24.2	SW (26)	50%	29.5	21	19	-	
	25/11	11:58	70	24.8	SW (26)	50%	31.2	21.4	19	-	
			71								
			72								
	23/11	8:30	73	16.3	SSW (17)	97%	15.7	16.8	19	-	
	23/11	8:40	74	16.3	SSW (17)	97%	16.9	17.7	19	-	
	23/11	8:15	75	16.3	SSW (17)	97%	15.7	16.3	19	-	
	26/11	13:25	76	19.1	SSE (22)	58%	43.3	31.4	31	-	
	26/11	13:15	77	19.1	SSE (22)	58%	45.1	33	29	-	
Wk 10			28								
			29								
			30								
			31								
			32								
			33								
			34								
			35								
			36								
			37								
			38								
			39								
			40								
	30/11	10:15	41	16.4	E (20)	69%	39.6	33.5	24	-	HM
	30/11	10:30	42	16.4	E (20)	69%	40.7	27.5	23	-	
	30/11	9:35	43	16.4	E (20)	69%	28.9	20.6	21	-	

	2020 Date	Time	Grid #	Temp (°C)	Wind	Humidity	Above Tile Temp C°	Below Tile Temp	Soil Temp C°	SLL	Other Species
	30/11	9:25	44	16.4	E (20)	69%	24.5	14.8	20	-	2xBTL
	30/11	9:10	45	16.4	E (20)	69%	27.8	25.5	19	-	BTL
	30/11	9:50	46	16.4	E (20)	69%	30.8	24.3	21	-	
	30/11	10:00	47	16.4	E (20)	69%	29.3	19.6	20	-	
	30/11	10:05	48	16.4	E (20)	69%	39.7	30.9	23	-	
			49								
			50								
			51								
			52								
			53								
			54								
			55								
			56								
			57								
	30/11	8:15	58	16.4	E (20)	69%	17.6	17.4	19	-	
	30/11	8:30	59	16.4	E (20)	69%	18.2	16	18	-	
			60								
			61								
			62								
			63								
			64								
			65								
			66								
			67								
			68								
			69								
			70								
			71								
			72								
	30/11	12:30	73	18.2	ESE (26)	60%	55.4	36.7	25	-	
	30/11	13:15	74	18.2	ESE (26)	60%	55.8	45	25	-	
	30/11	12:20	75	18.2	ESE (26)	60%	63.4	46.3	28	-	
	30/11	11:25	76	17.7	ESE (19)	64%	42.4	28.7	24	-	
	30/11	11:35	77	17.7	ESE (19)	64%	40.4	25.4	25	-	

Appendix 4.2 – Striped Legless Lizard Survey Data 2020/2021 - WGGA

Table A4.2.1. Survey data and weather conditions for the Striped Legless Lizard Tile Checks – WGGA

	2020 Date	Time	Grid #	Temp(°C)	Wind	Humidity	Above Tile Temp C°	Below Tile Temp	Soil Temp C°	SLL	Other Species
	29/09	14:41	1	18.4	NE(6)	53%	33.5	25.3	21.1	-	
	29/09	15:10	2	18.5	NE(6)	53%	33	26.3	19	-	
	29/09	14:19	3	17.9	NE(11)	53%	34.6	30.4	19	-	
	29/09	13:11	4	16.4	ENE(9)	59%	38	28	15	-	
	29/09	12:44	5	15.6	NE(11)	65%	32	21	17.5	-	
	29/09	11:45	6	14.9	NE(11)	69%	24	14	18.5	-	
	29/09	11:22	7	13.6	ENE(11)	74%	33.8	20.2	15	-	
	29/09	11:00	8	12.8	NE(13)	75%	24	10.6	13	-	
	29/09	10:15	9	12.8	NE(13)	75%	23.3	17.7	14.6	-	
	29/09	12:16	10	14.8	NE(13)	67%	25	23	18	-	
	29/09		11								
	01/10		12								
	01/10		13								
Wk 1	29/09	11:44	14	21	NNE(7)	52%	30.2	14.5	17	-	
	29/09	11:34	15	21	NNE(7)	52%	29.6	16	18	-	
	29/09	11:23	16	21	NNE(7)	52%	30.3	15.7	17	-	
	29/09	11:10	17	21	NNE(7)	52%	31	15.5	18	-	
	30/09	14:40	18	17.2	N(24)	67%	20.8	17.5	17	-	
	30/09	15:00	19	17.2	N(24)	67%	18.9	13.8	18	-	
	30/09	15:15	20	17.2	N(24)	67%	16.5	14	17	-	
	30/09	15:35	21	17.2	N(24)	67%	18	15.5	16	-	
	30/09	16:00	22	17.2	N(24)	67%	17.2	14.6	18	-	
	30/09	15:25	23	17.2	N(24)	67%	17.5	13.3	17	-	
	30/09	16:15	24	17.2	N(24)	67%	19	15.6	16	-	
	30/09	16:30	25	17.2	N(24)	67%	19	15.5	17	-	
	30/09	17:05	26	17.2	N(24)	67%	18.7	16.5	16	-	
	30/09	16:50	27	17.2	N(24)	67%	20.4	17.4	16	-	BS
			1								
			2								
Wk 2			3								
			4								
			5								

	2020 Date	Time	Grid #	Temp(ºC)	Wind	Humidity	Above Tile Temp Cº	Below Tile Temp	Soil Temp Cº	SLL	Other Species
			6								
			7								
			8								
			9								
			10								
	06/10	13:22	11	11.6	SSE(24)	X	16	13.4	15	-	
	06/10	13:30	12	11.6	SSE(24)	X	15.3	10.6	14	-	
	06/10	13:45	13	11.6	SSE(24)	X	18	11.9	15	-	
	07/10	10:00	14	11.6	Calm	97%	13.7	12.3	13	-	
	07/10	9:50	15	11.6	Calm	97%	14.1	12.3	13	-	
	07/10	9:28	16	11.6	Calm	97%	11.1	8.4	13	-	2xSMF
	07/10	9:41	17	11.6	Calm	97%	11.9	10.4	14	-	
			18								
			19								
			20								
			21								
			22								
			23								
			24								
			25								
			26								
			27								
Wk 3	13/10	12:18	1	14.4	S(19)	X	25.6	16.5	17	-	
	13/10	12:02	2	14.4	S(19)	X	27	17.5	19	-	
	13/10	12:36	3	14.4	S(19)	X	33.8	22.8	18	-	GS
	13/10	12:50	4	14.4	S(19)	X	39.1	24.2	19	-	
	13/10	10:45	5	13.5	S(19)	X	24.4	21.3	17	-	
	13/10	11:30	6	14.4	S(19)	X	27.5	18.8	17	-	
	13/10	11:46	7	14.4	S(19)	X	26.9	17.9	19	-	
	13/10	10:50	8	13.5	S(19)	X	25.8	16.1	17	-	7 x HM
	13/10	11:07	9	13.5	S(19)	X	22.1	19	18	-	GS, BTL
	13/10	11:15	10	13.5	S(19)	X	24.5	17.2	19	-	
	13/10	10:30	11	13.5	S(19)	X	22.1	16.4	18	-	
	13/10	10:25	12	13.5	S(19)	X	19.6	16.1	18	-	

	2020 Date	Time	Grid #	Temp(ºC)	Wind	Humidity	Above Tile Temp Cº	Below Tile Temp	Soil Temp Cº	SLL	Other Species
	13/10	10:20	13	13.5	S(19)	X	19.5	13.9	17	-	
	13/10	10:15	14	13.5	S(19)	X	19.7	14.3	17	-	
	13/10	10:10	15	13.5	S(19)	X	20	16.3	17	-	
	13/10	9:50	16	13.5	S(19)	X	21.5	15.2	16	-	
	13/10	10:00	17	13.5	S(19)	X	21.3	15.3	16	-	
	14/10	9:50	18	13.6	ENE(7)	81%	16.4	14.5	15	-	
	14/10	10:00	19	13.6	ENE(7)	81%	16.7	15.4	16	-	2xSMF
	14/10	10:30	20	13.8	ENE(9)	81%	18.4	15.4	17	-	
	14/10	10:40	21	13.8	ENE(9)	81%	20.3	17.1	16	-	
	14/10	10:55	22	13.8	ENE(9)	81%	19.9	15.7	18	-	
	14/10	10:15	23	13.6	ENE(7)	81%	17.6	13.2	16	-	
	14/10	11:05	24	14	NE(6)	81%	20.9	18.6	17	-	
	14/10	11:30	25	14.6	NE(6)	81%	25.7	19.7	19	-	
	14/10	11:40	26	14.6	NE(6)	81%	27.1	21.7	19	-	
	14/10	12:00	27	15	NE(6)	81%	29.1	24.2	19	-	HM
	19/10	14:30	1	14.4	SW(13)	77%	21	14.8	18	-	
	19/10	14:45	2	14.4	SW(13)	77%	23.3	16.6	18	-	
	19/10	14:15	3	14.4	SW(13)	77%	26.4	15.6	18	-	3xGS
	19/10	15:00	4	14.4	SW(13)	77%	27	16.6	19	-	BS
	19/10	12:20	5	14.4	SW(13)	77%	22.5	19.4	17	-	
	19/10	13:45	6	14.4	SW(13)	77%	24.5	14.3	17	-	SMF
	19/10	14:00	7	14.4	SW(13)	77%	24.9	18.8	19	-	
	19/10	12:35	8	14.4	SW(13)	77%	22	13.7	18	-	
	19/10	13:15	9	14.4	SW(13)	77%	21.9	15.8	17	-	
Wk 4	19/10	13:30	10	14.4	SW(13)	77%	19.8	15.7	19	-	SMF, GS
	20/10	11:45	11	14	ESE(9)	67%	24.6	16	19	-	
	20/10	11:32	12	14	ESE(9)	67%	25.1	16	20	-	
	20/10	11:23	13	14	ESE(9)	67%	26.5	17.9	17	-	
	20/10	11:10	14	14	ESE(9)	67%	24.7	15.8	16	-	
	20/10	11:00	15	14	ESE(9)	67%	20.5	16.6	16	-	
	20/10	10:45	16	14	ESE(9)	67%	27.2	16	15	-	
	20/10	10:56	17	14	ESE(9)	67%	26.7	16.4	15	-	
	21/10	9:50	18	11	SSW(4)	68%	20	13.6	14	-	
	21/10	9:55	19	11	SSW(4)	68%	25.3	14.9	15	-	

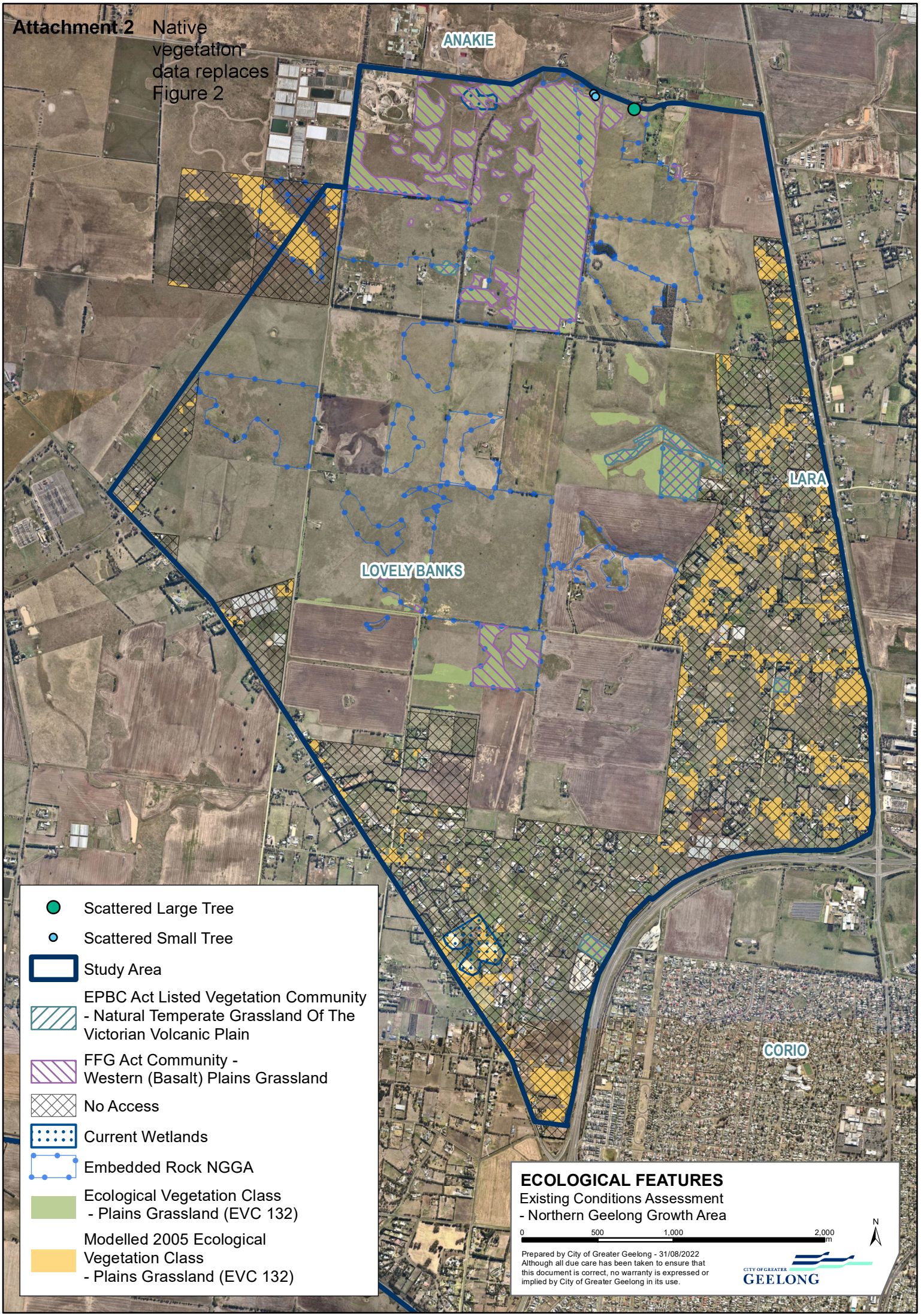
	2020 Date	Time	Grid #	Temp(ºC)	Wind	Humidity	Above Tile Temp Cº	Below Tile Temp	Soil Temp Cº	SLL	Other Species
	21/10	10:17	20	11	SSW(4)	68%	33.5	17.7	18	-	
	21/10	10:26	21	15	E(6)	68%	38	27.9	18	-	
	21/10	10:34	22	16	SSW(9)	68%	40	20.1	24	-	
	21/10	10:10	23	11	SSW(4)	68%	21.4	15.7	15	-	
	21/10	10:57	24	16	SSW(9)	68%	17.6	13.5	15	-	
	21/10	11:01	25	16	SSW(9)	68%	30	25	18	-	
	21/10	11:15	26	16	SSW(9)	68%	30	23.5	17	-	
	21/10	11:30	27	16	SSW(9)	68%	31.2	19	17	-	
Wk 5	27/10	12:55	1	17.1	ESE(28)	59%	25.9	22.5	18	-	3 x HM
	27/10	12:35	2	14.9	ESE(24)	66%	34.3	27.1	18	-	
	27/10	13:05	3	17.1	ESE(28)	59%	50.4	24.6	19	-	GS
	27/10	13:25	4	17.1	ESE(28)	59%	43.6	31.5	19	-	
	27/10	11:20	5	14.9	ESE(24)	66%	22.9	17.2	15	-	2xGS
	27/10	12:15	6	14.9	ESE(24)	66%	30	17.6	16	-	
	27/10	12:25	7	14.9	ESE(24)	66%	32.2	19.1	18	-	
	27/10	11:50	8	14.9	ESE(24)	66%	24.3	15.5	18	-	3 x HM
	27/10	11:45	9	14.9	ESE(24)	66%	24.5	18.5	17	-	
	27/10	12:00	10	14.9	ESE(24)	66%	25.5	10.5	17	-	
	27/10	14:30	11	17	ESE(43)	55%	32.3	13.4	22	-	
	27/10	14:20	12	17	ESE(43)	55%	29.3	14.2	19	-	
	27/10	14:15	13	17	ESE(43)	55%	34	17.6	19	-	
	27/10	14:10	14	17	ESE(43)	55%	32.1	14.4	20	-	
	27/10	14:00	15	17	ESE(43)	55%	32.1	11.5	19	-	
	27/10	13:40	16	17.1	ESE(28)	59%	31.3	15.8	19	-	
	27/10	13:55	17	17.1	ESE(28)	59%	29	9.3	20	-	
	28/10	12:40	18	18.3	ESE(7)	66%	36.1	21.7	22	-	
	28/10	12:50	19	18.3	ESE(7)	66%	46.5	25.7	23	-	
	28/10	13:15	20	18.3	ESE(7)	66%	51.4	31.7	27	-	
	28/10	13:25	21	18.3	ESE(7)	66%	49.7	34.5	24	-	
	28/10	13:35	22	18.3	ESE(7)	66%	53.1	30.7	28	-	
	28/10	13:05	23	18.3	ESE(7)	66%	48.3	33.2	23	-	
	28/10	13:45	24	17.7	SSE(11)	72%	47.3	31.2	26	-	
	28/10	13:55	25	17.7	SSE(11)	72%	49.3	31.4	26	-	
	28/10	14:10	26	17.7	SSE(11)	72%	50.8	31.7	26	-	

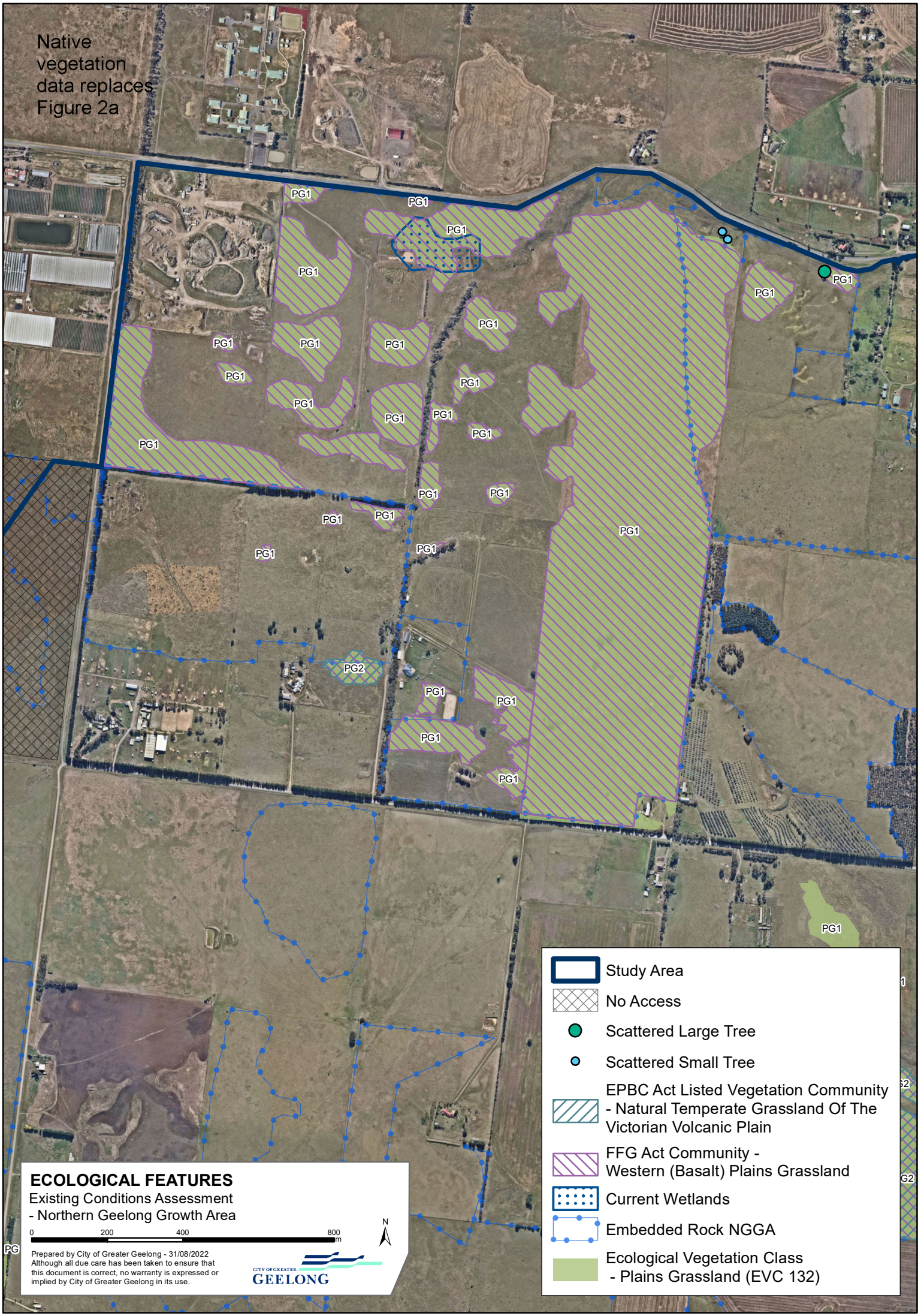
	2020 Date	Time	Grid #	Temp(ºC)	Wind	Humidity	Above Tile Temp Cº	Below Tile Temp	Soil Temp Cº	SLL	Other Species
	28/10	14:25	27	17.7	SSE(11)	72%	51.3	30.5	26	-	
Wk 6	04/11	14:05	1	16.1	SSW(30)	86%	24.7	19.3	21	-	HM
	04/11	13:50	2	16.1	SSW(30)	86%	25.3	19.5	20	-	GS
	04/11	14:15	3	16.1	SSW(30)	86%	21	18.7	20	-	2x GS
	04/11	14:30	4	16.1	SSW(30)	86%	31.9	27.3	21	-	BTL
	04/11	14:50	5	16.1	SSW(30)	86%	26.1	21.4	22	-	
	06/11	10:25	6	14	W(15)	66%	17.3	10.9	19	-	
	06/11	10:45	7	17	W(15)	75%	18.7	17.2	19	-	GS, 2 x HM
	06/11	9:30	8	14	W(15)	66%	22.3	15.1	19	-	
	06/11	9:45	9	14	W(15)	66%	17.2	14.4	16	-	GS
	06/11	10:00	10	14	W(15)	66%	18.6	16.4	18	-	GS
	04/11	10:40	11	19.8	WNW(7)	75%	19.1	19.5	22	-	
	04/11	10:30	12	19.8	WNW(7)	75%	19.2	19.3	22	-	
	04/11	10:20	13	19.8	WNW(7)	75%	18.9	19.9	22	-	
	04/11	10:10	14	19.8	WNW(7)	75%	18.7	19.4	22	-	
	04/11	9:55	15	19.8	WNW(7)	75%	18.6	18.7	21	-	
	04/11	9:30	16	19.8	WNW(7)	75%	19.4	19.2	20	-	
	04/11	9:45	17	19.8	WNW(7)	75%	18.7	19.1	22	-	
	04/11	11:00	18	20	WSW(20)	84%	15.8	14.5	19	-	
	04/11	11:15	19	17.1	WSW(20)	84%	17.3	15.6	20	-	
	04/11	11:40	20	17.1	WSW(20)	84%	16.9	17.8	20	-	
	04/11	11:50	21	17.1	WSW(20)	84%	17.1	16.3	19	-	SMF
	04/11	12:00	22	17.1	WSW(20)	84%	18.2	18.6	20	-	
	04/11	11:30	23	17.1	WSW(20)	84%	16.7	17	20	-	
	04/11	12:15	24	16.9	WSW(22)	84%	18.6	18.6	20	-	
	04/11	12:30	25	16.9	WSW(22)	84%	19.9	19.1	20	-	
	04/11	12:40	26	16.9	WSW(22)	84%	20.4	19	20	-	
	04/11	12:55	27	16.9	WSW(22)	84%	22.1	20.4	21	-	
Wk 7	10/11	9:50	1	25.8	N(28)	X	31.2	21.4	20	-	HM
	10/11	10:05	2	25.8	N(28)	X	30.4	22.4	21	-	HM
	10/11	10:20	3	25.8	N(28)	X	35.3	25.5	21	-	
	10/11	10:40	4	27.7	N(26)	X	35.3	28.5	22	-	
	10/11	8:20	5	20.9	NE(15)	X	18.5	17.9	19	-	
	10/11	9:20	6	20.9	NE(15)	X	26.1	19.7	21	-	

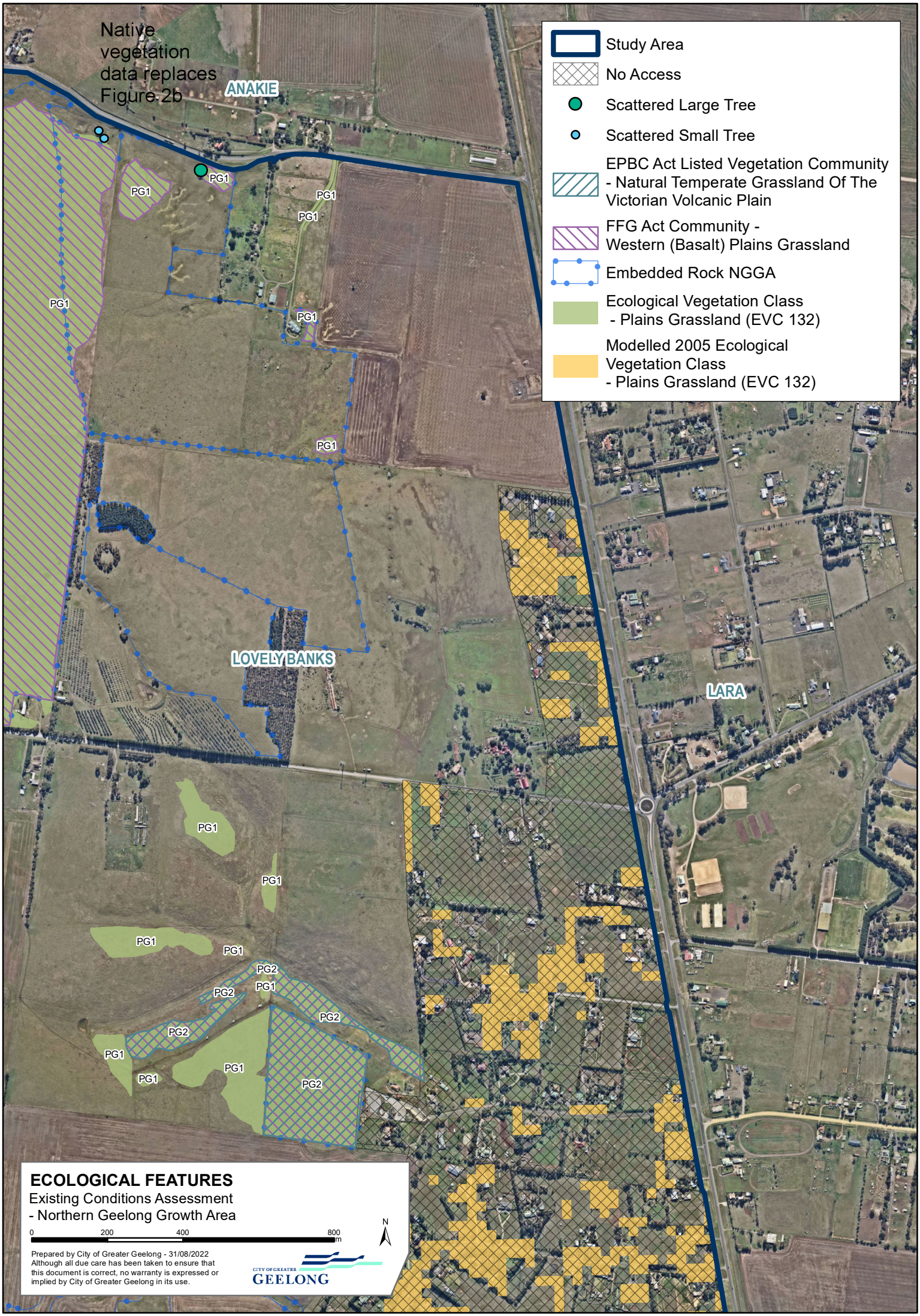
	2020 Date	Time	Grid #	Temp(ºC)	Wind	Humidity	Above Tile Temp Cº	Below Tile Temp	Soil Temp Cº	SLL	Other Species
	10/11	9:30	7	25.8	N(28)	X	27.6	23.8	21	-	2xHM
	10/11	8:35	8	20.9	NE(15)	X	21.3	19.1	18	-	HM
	10/11	8:50	9	20.9	NE(15)	X	19.3	18.9	19	-	HM
	10/11	9:05	10	20.9	NE(15)	X	2.2	17.7	19	-	
	10/11	12:20	11	29.5	NNE(9)	X	43.6	31.2	28	-	
	10/11	12:10	12	29.5	NNE(9)	X	42.1	27.5	26	-	
	10/11	12:00	13	29.5	NNE(9)	X	43.3	25.1	25	-	
	10/11	11:50	14	29.5	NNE(9)	X	44	26.3	28	-	
	10/11	11:35	15	27.7	NE(17)	X	42.5	27.1	27	-	
	10/11	11:10	16	27.7	NE(17)	X	32.2	23.2	24	-	
	10/11	11:20	17	27.7	NE(17)	X	36.1	29.2	28	-	SMF
	11/11	9:30	18	21.5	NNE(2)	62%	19.1	18.6	20	-	
	11/11	9:42	19	21.5	NNE(2)	62%	19.7	20.5	22	-	
	11/11	10:05	20	21.5	NNE(2)	62%	21.9	22.5	23	-	
	11/11	10:20	21	21.5	NNE(2)	62%	21.4	20.5	22	-	
	11/11	10:55	22	21.5	NNE(2)	62%	22.1	22.4	23	-	
	11/11	9:50	23	21.5	NNE(2)	62%	19.7	19.8	22	-	
	11/11	8:30	24	23.8	NNE(11)	49%	21	20.3	22	-	GS
	11/11	8:45	25	23.8	NNE(11)	49%	19.8	20.1	22	-	
	11/11	9:00	26	23.8	NNE(11)	49%	20.2	18.6	22	-	
	11/11	9:15	27	23.8	NNE(11)	49%	20.9	21	23	-	
Wk 8	17/11	12:15	1	17.9	W(15)	58%	44.3	39.6	22	-	HM
	17/11	12:30	2	17.9	W(15)	58%	36.2	19.6	22	-	
	17/11	12:40	3	17.9	W(15)	58%	43.2	25.3	21	-	
	17/11	13:00	4	19.1	S(26)	58%	37.5	27.2	22	-	
	17/11	11:02	5	17.2	WSW(24)	58%	39	27.9	21	-	2xHM
	17/11	11:50	6	17.9	W(15)	58%	41.7	20.6	23	-	
	17/11	12:00	7	17.9	W(15)	58%	38.9	25.9	21	-	3xHM
	17/11	11:18	8	17.2	WSW(24)	58%	49.2	26.4	24	-	
	17/11	11:25	9	17.2	WSW(24)	58%	42.2	36.3	23	-	
	17/11	11:40	10	17.9	W(15)	58%	41.9	30	27	-	3xHM
	17/11	14:00	11	21	S(26)	58%	41.6	28.1	22	-	
	17/11	14:15	12	21	S(26)	58%	43.4	27.8	22	-	
	17/11	14:30	13	21	S(26)	58%	40.7	29.2	21	-	

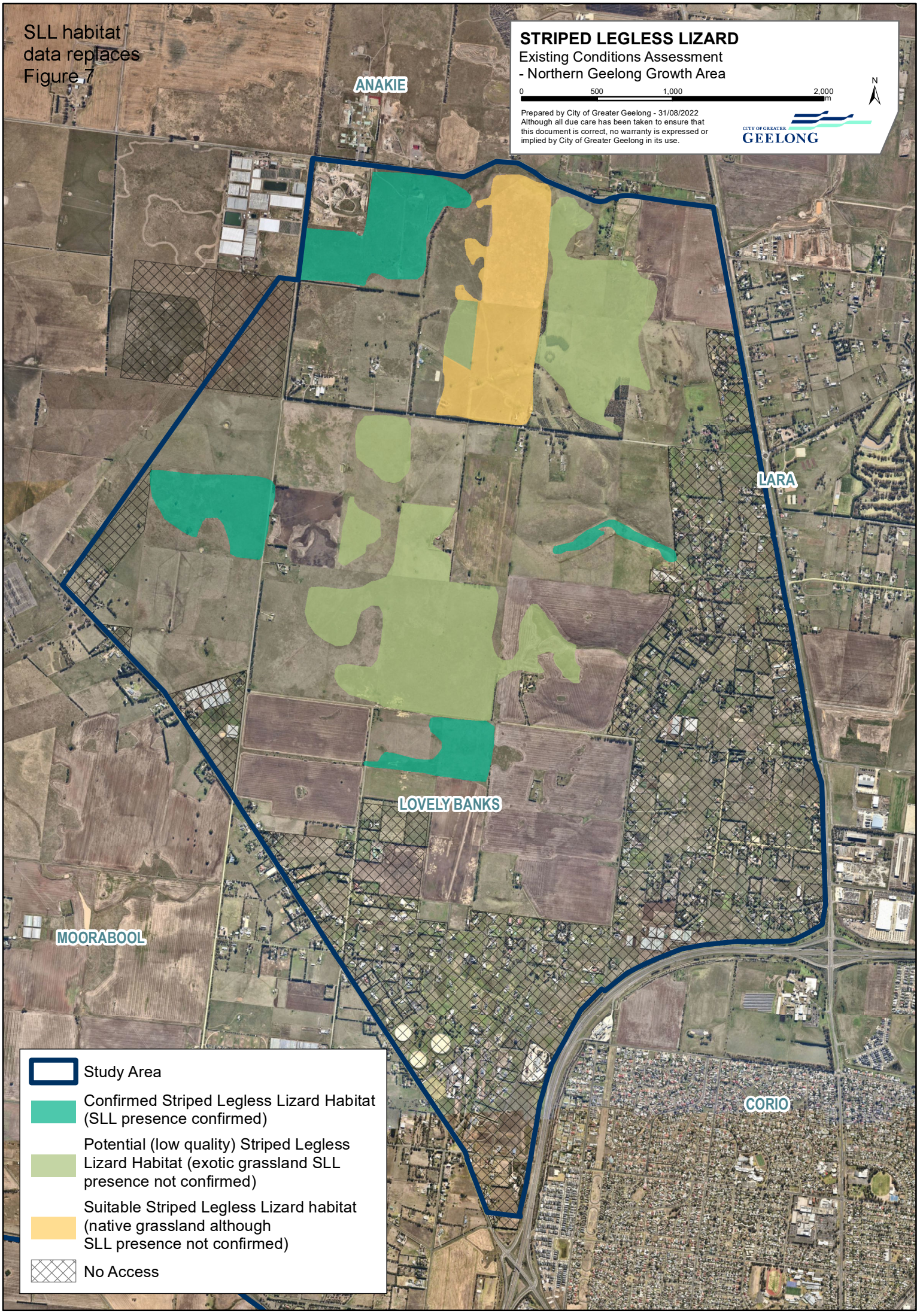
	2020 Date	Time	Grid #	Temp(ºC)	Wind	Humidity	Above Tile Temp Cº	Below Tile Temp	Soil Temp Cº	SLL	Other Species
			14								
			15								
			16								
			17								
			18								
			19								
			20								
			21								
			22								
			23								
			24								
			25								
			26								
			27								
Wk 9	25/11	8:13	1	17.6	SW (26)	74%	31.5	18.2	17	-	
	25/11	8:22	2	17.6	SW (26)	74%	29.6	17.6	17	-	
	25/11	8:35	3	17.8	SW (26)	74%	31.1	18.8	18	-	2xGS
	25/11	8:45	4	17.8	SW (26)	74%	32.3	19.5	18	-	
	25/11	8:58	5	18.2	SW (26)	74%	33.4	19.5	18	-	
	25/11	9:10	6	18.2	SW (26)	70%	33.8	19.1	18	-	
	25/11	9:21	7	18.5	SW (26)	70%	33.1	20.4	18	-	
	25/11	9:35	8	18.6	SW (26)	65%	31.6	19.6	19	-	
	25/11	9:49	9	19.1	SW (26)	65%	32.8	19.8	19	-	
	25/11	10:02	10	19.2	SW (26)	65%	33.5	20.4	19	-	GS
	25/11	10:35	11	19.8	SW (26)	65%	33.5	22.1	19	-	
	25/11	10:45	12	21.6	SW (26)	65%	34.1	20.7	19	-	
	25/11	11:03	13	22.7	SW (26)	60%	32	21.6	20	-	HM
	25/11	11:13	14	23.2	SW (26)	50%	35.6	21.9	21	-	
	25/11	11:25	15	23.3	SW (26)	50%	34.5	19.6	20	-	SMF
	25/11	11:41	16	24.1	SW (26)	50%	35.7	23.4	20	-	
	25/11	11:59	17	24.8	SW (26)	50%	36.4	23.8	20	-	
	26/11	8:55	18	16.7	SSW (31)	81%	23.8	16.9	17	-	GS
	26/11	9:09	19	16.9	SSW (31)	81%	24.9	17.5	17	-	
	26/11	9:24	20	17.1	SSW (31)	81%	22.9	18.3	17	-	

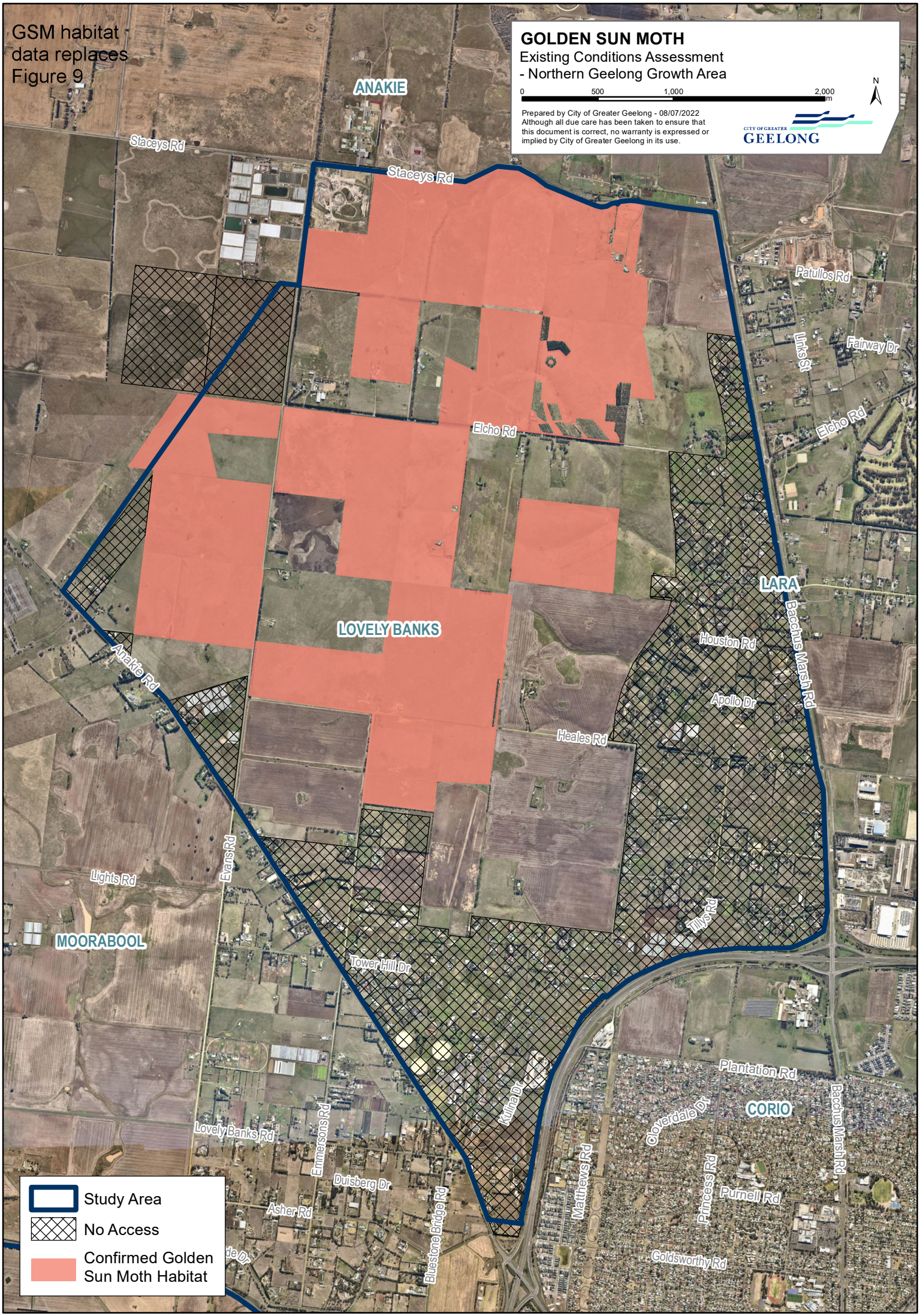
	2020 Date	Time	Grid #	Temp(ºC)	Wind	Humidity	Above Tile Temp Cº	Below Tile Temp	Soil Temp Cº	SLL	Other Species
	26/11	9:39	21	17	SSW (31)	81%	24.6	18.1	17	-	
	26/11	9:52	22	17.2	SSW (31)	75%	23.1	16.7	17	-	
	26/11	10:05	23	17.5	SSW (31)	75%	24.3	16	17	-	HM x 2
	26/11	10:18	24	17.6	SSW (31)	75%	20.8	17.8	17	-	
	26/11	10:39	25	17.8	SSW (31)	75%	21.6	18.6	17	-	
	26/11	10:53	26	17.8	SSW (31)	75%	22.5	18.6	17	-	HM x 2
	26/11	11:06	27	17.9	SSW (31)	70%	23.7	17.5	17	-	
Wk 10			1								
			2								
			3								
			4								
			5								
			6								
			7								
			8								
			9								
			10								
			11								
			12								
			13								
			14								
			15								
			16								
			17								
	30/11	9:15	18	17.1	ESE (21)	59%	22.6	17.5	17	-	
	30/11	9:28	19	17.4	ESE (21)	59%	22.8	17.9	17	-	
	30/11	9:43	20	17.4	ESE (21)	59%	23.1	18.8	18	-	GS
	30/11	9:55	21	17.9	ESE (21)	59%	23.5	18.8	18	-	
	30/11	10:11	22	18.4	ESE (21)	59%	23.5	20.6	18	-	
	30/11	10:25	23	18.4	ESE (21)	59%	24.2	21.4	19	-	
	30/11	10:39	24	18.5	ESE (21)	59%	24.1	23.5	19	-	
	30/11	11:11	25	19.7	ESE (24)	59%	19.6	18.1	16	-	GS
	30/11	11:28	26	20.3	ESE (24)	59%	19.8	18.6	16	-	
	30/11	11:40	27	21.4	ESE (24)	59%	20.1	19.1	16	-	


Attachment 2 Native vegetation data replaces Figure 2
ANAKIE
LARA
LOVELY BANKS
CORIO
Scattered Large Tree
Scattered Small Tree
Study Area
EPBC Act Listed Vegetation Community - Natural Temperate Grassland Of The Victorian Volcanic Plain
FFG Act Community - Western (Basalt) Plains Grassland
No Access
Current Wetlands
Embedded Rock NGGA
Ecological Vegetation Class - Plains Grassland (EVC 132)
Modelled 2005 Ecological Vegetation Class - Plains Grassland (EVC 132)
ECOLOGICAL FEATURES
Existing Conditions Assessment
- Northern Geelong Growth Area
0 500 1,000 2,000 m
N
Prepared by City of Greater Geelong - 31/08/2022
Although all due care has been taken to ensure that this document is correct, no warranty is expressed or implied by City of Greater Geelong in its use.
CITY OF GREATER GEELONG


Native vegetation data replaces Figure 2a
PG1
PG2
Study Area
No Access
Scattered Large Tree
Scattered Small Tree
EPBC Act Listed Vegetation Community - Natural Temperate Grassland Of The Victorian Volcanic Plain
FFG Act Community - Western (Basalt) Plains Grassland
Current Wetlands
Embedded Rock NGGA
Ecological Vegetation Class - Plains Grassland (EVC 132)
ECOLOGICAL FEATURES
Existing Conditions Assessment
- Northern Geelong Growth Area
0 200 400 800 m
N
Prepared by City of Greater Geelong - 31/08/2022
Although all due care has been taken to ensure that this document is correct, no warranty is expressed or implied by City of Greater Geelong in its use.
CITY OF GREATER GEELONG


Native vegetation data replaces Figure 2b
ANAKIE
LOVELY BANKS
LARA
PG1
PG2
Study Area
No Access
Scattered Large Tree
Scattered Small Tree
EPBC Act Listed Vegetation Community - Natural Temperate Grassland Of The Victorian Volcanic Plain
FFG Act Community - Western (Basalt) Plains Grassland
Embedded Rock NGGA
Ecological Vegetation Class - Plains Grassland (EVC 132)
Modelled 2005 Ecological Vegetation Class - Plains Grassland (EVC 132)
ECOLOGICAL FEATURES
Existing Conditions Assessment
- Northern Geelong Growth Area
0
200
400
800
m
N
Prepared by City of Greater Geelong - 31/08/2022
Although all due care has been taken to ensure that this document is correct, no warranty is expressed or implied by City of Greater Geelong in its use.
CITY OF GREATER GEELONG


SLL habitat data replaces Figure 7
STRIPED LEGLESS LIZARD
Existing Conditions Assessment
- Northern Geelong Growth Area
0
500
1,000
2,000
m
N
Prepared by City of Greater Geelong - 31/08/2022
Although all due care has been taken to ensure that this document is correct, no warranty is expressed or implied by City of Greater Geelong in its use.
CITY OF GREATER GEELONG
ANAKIE
LARA
LOVELY BANKS
MOORABOOL
CORIO
Study Area
Confirmed Striped Legless Lizard Habitat (SLL presence confirmed)
Potential (low quality) Striped Legless Lizard Habitat (exotic grassland SLL presence not confirmed)
Suitable Striped Legless Lizard habitat (native grassland although SLL presence not confirmed)
No Access


GSM habitat data replaces Figure 9
GOLDEN SUN MOTH
Existing Conditions Assessment
- Northern Geelong Growth Area
0
500
1,000
2,000
m
N
Prepared by City of Greater Geelong - 08/07/2022
Although all due care has been taken to ensure that this document is correct, no warranty is expressed or implied by City of Greater Geelong in its use.
CITY OF GREATER GEELONG
ANAKIE
Staceys Rd
Staceys Rd
Patullos Rd
Links St
Fairway Dr
Elcho Rd
Elcho Rd
LARA
LOVELY BANKS
Houston Rd
Bacchus Marsh Rd
Apollo Dr
Anakie Rd
Heales Rd
Evans Rd
Lights Rd
MOORABOOL
Tilys Rd
Tower Hill Dr
Plantation Rd
CORIO
Cloverdale Dr
Kulma Dr
Bacchus Marsh Rd
Lovely Banks Rd
Emmersons Rd
Dufsberg Dr
Asher Rd
Bluestone Bridge Rd
Matthews Rd
Princess Rd
Purnell Rd
Goldsworthy Rd
Study Area
No Access
Confirmed Golden Sun Moth Habitat