Part 4: Impact assessment

NWGGA Strategic Assessment Report

Public re-exhibition version

DOCUMENT TRACKING

PREPARED BY:	
Heather Tolley, Heidi Birkby, Peter Hemphill, Natasha Buckingham (Open Lines)	
REVIEWED BY:	
Heather Tolley, Peter Hemphill (Open Lines) Mitchell Deaves (Biosis)	
VERSION CONTROL:	
VERSION:	Public re-exhibition version
DATE:	November 2025

Contents

PART 4: IMPACT ASSESSMENT 15-1

15 INTRODUCTION 15-1

16 AVOIDANCE OF IMPACTS 16-1

16.1 Introduction 16-1

16.2 How avoidance is defined for the purposes of the strategic assessment 16-1

16.3 Steps to avoid and minimise impacts 16-1

16.4 Commitments and measures for avoidance 16-3

16.5 Avoidance outcomes for MNES 16-3

17 MANAGING INDIRECT IMPACTS 17-1

17.1 Introduction 17-1

17.2 Analysis of indirect impacts 17-2

17.3 Analysis of Threat Abatement Plans 17-12

18 RELEVANT PROTECTED MATTERS 18-1

18.1 Introduction 18-1

18.2 Categorisation results 18-1

19 LISTED THREATENED FAUNA 19-1

Known to occur within the Growth Areas 19-1

19.1 Golden Sun Moth (*Synemon plana*) 19-1

19.2 Growling Grass Frog (*Litoria raniformis*) 19-12

19.3 Striped Legless Lizard (*Delma impar*) 19-29

Potential to occur within the growth areas 19-41

19.4 Blue-winged Parrot (*Neophema chrysostoma*) 19-41

19.5 Victorian Grassland Earless Dragon (*Tympanocryptis pinguicolla*) 19-46

Occur outside the Growth Areas 19-62

19.6 Combined species assessment 19-62

20 LISTED THREATENED FLORA 20-1

Known to occur within the Growth Areas 20-1

20.1 Adamson's Blown-grass *(Lachnagrostis adamsonii)* 20-1

Occur outside the Growth Areas 20-8

20.2 Spiny Rice-flower *(Pimelea spinescens* subsp. *spinescens)* 20-8

21 LISTED THREATENED ECOLOGICAL COMMUNITIES 21-1

Known to occur within the Growth Areas 21-1

21.1 Natural temperate grassland of the victorian volcanic plain 21-1

22 RAMSAR WETLANDS 22-1

22.1 Introduction 22-1

22.2 Regulatory context 22-1

22.3 General Description of the Ramsar site 22-2

22.4 Ramsar listing criteria 22-2

22.5 Summary of the ecological character 22-4

22.6 How the Growth Areas relate to the Ramsar site 22-10

22.7 Analysis of potential impacts 22-10

22.8 Addressing obligations under the Ramsar convention 22-17

23 NON-THREATENED MIGRATORY SPECIES 23-1

23.1 Introduction 23-1

23.2 Regulatory requirements 23-1

23.3 Identification of species requiring assessment 23-2

23.4 .Assessment of migratory shorebirds 23-3

24 FINALISED PRIORITY ASSESSMENT LIST (FPAL) 24-1

25 CUMULATIVE IMPACT ASSESSMENT 25-1

25.1 Introduction 25-1

25.2 Requirements and purpose of the CIA 25-1

25.3 Overview and structure 25-2

25.4 Cumulative impacts and threatening processes 25-2

25.5 MNES subject to the CIA 25-3

25.6 Quantitative CIA 25-4

25.7 Qualitative CIA 25-11

26 SOCIO-ECONOMIC IMPACT ASSESSMENT 26-1

26.1 Introduction 26-1

26.2 Approach to the socio-economic impact assessment 26-1

26.3 Socio-economic impact assessment 26-4

26.4 Consultation and procedural fairness 26-15

REFERENCES ..... A

List of Tables

Table 16-1: MNES that will be avoided entirely from being impacted directly by implementation of the Plan 16-5

Table 17-1: Sites within the Geelong region with existing management in place to minimise human disturbance..... 17-8

Table 17-2: Key Threatening Processes (KTPs) associated with potential impacts under the Plan..... 17-13

Table 17-3: Threat Abatement Plans associated with potentially relevant Key Threatening Processes 17-13

Table 19-1: Golden Sun Moth habitat occurring within surveyed areas of the NGGA..... 19-5

Table 19-2: GSM habitat occurring across the broader Study Area 19-6

Table 19-3: Relevant Key Threatening Processes and associated Threat Abatement Plans for the Golden Sun Moth ... 19-11

Table 19-4: Relevant Key Threatening Processes and associated Threat Abatement Plans for GGF 19-28

Table 19-5: Relevant Key Threatening Processes and associated Threat Abatement Plans for the Striped Legless Lizard 19-40

Table 19-6: Relevant Key Threatening Processes and associated Threat Abatement Plans for the Blue-winged Parrot 19-44

Table 19-7: Relevant Key Threatening Processes and associated Threat Abatement Plans for the Victorian Grassland Earless Dragon 19-61

Table 19-8: The occurrence in the Study Area and relevant indirect impacts under the Plan for each of the bird species considered in the combined assessment..... 19-64

Table 19-9: The occurrence in the Study Area and relevant indirect impacts under the Plan for each of the fish species considered in the combined assessment..... 19-69

Table 19-10: Sites within the Geelong region with existing management in place to minimise human disturbance..... 19-75

Table 20-1: Relevant Key Threatening Processes and associated Threat Abatement Plans for Adamson's Blown-grass 20-7

Table 20-2: Relevant Key Threatening Processes and associated Threat Abatement Plans for Spiny Rice-flower..... 20-13

Table 21-1: Relevant Key Threatening Processes and associated Threat Abatement Plans for Adamson's Blown Grass 21-8

Table 22-1: Criteria for Ramsar listing (DELWP, 2020)..... 22-3

Table 22-2: High level summary of the ecological character of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site (adapted from (DEWHA, 2008b))..... 22-5

Table 22-3: Priority threats at the relevant locations of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site (DELWP, 2020)..... 22-11

Table 23-1: Overview of Category 1 migratory shorebirds 23-4

Table 23-2: Existing management of important shorebird habitat within the Study Area..... 23-11

Table 25-1: Other projects included in the quantitative cumulative impact assessment and data availability..... 25-6

Table 25-2: Potential cumulative impacts to species and TECs directly impacted by Plan..... 25-9

Table 26-1: Components considered to be relevant to the Plan for each of the socio-economic aspects as defined in (Vanclay, Esteves et al., 2015)..... 26-2

PART 4: IMPACT ASSESSMENT

15 Introduction

This part of the Assessment Report provides the detailed assessments for the relevant protected matters. As defined in the Terms of Reference (ToR), the relevant protected matters are those matters that may be impacted directly, indirectly and/or cumulatively by actions proposed to be taken under the Plan.

The detailed assessments are presented in the following chapters:

- Chapter 19 – Listed threatened fauna species
- Chapter 20 – Listed threatened flora species
- Chapter 21 – Listed threatened ecological communities
- Chapter 22 – Ramsar wetlands
- Chapter 23 – Listed migratory species
- Chapter 24 – Species on the Finalised Priority Assessment List
- Chapter 25 – Cumulative impact assessment
- Chapter 26 – Social and economic impact assessment

These assessments address many of the requirements of the ToR; in particular, sections 3.2, 4.1, 4.3, 4.4, 4.6 and 4.9.

There are a number of supporting chapters leading into these assessments that provide important background and context. These include:

- Chapter 16 – Avoidance, which describes the avoidance process and decision making that underpins the Plan and led to the key avoidance outcomes for MNES
- Chapter 17 – Managing indirect impacts, which describes the relevant potential indirect impacts associated with development under the Plan and how these impacts will be mitigated and managed
- Chapter 18 – Relevant protected matters, which lists the relevant protected matters that were identified through the categorisation method described in Chapter 12 of Part 3

16 Avoidance of impacts

16.1 INTRODUCTION

The ToR requires the SAR to include analysis of how impacts on MNES will be avoided. The relevant ToR is outlined in the following text box:

> *1.1. The Report must assess the impacts of actions under the Plan on all relevant protected matters*
>
> *1.2. The Report must address how those impacts will be avoided, mitigated and offset (where necessary or appropriate) to ensure the long-term protection of protected matters.*
>
> *…*
>
> *4.4. The Report must include analysis of:*
>
> *a) how impacts on protected matters will be avoided…*

This Chapter provides an analysis of avoidance and includes:

- How avoidance is defined for the purposes of the strategic assessment
- The steps taken to avoid and minimise impacts
- The avoidance outcomes for MNES

Where applicable, detailed discussion of the avoidance processes for individual MNES are presented in the remaining chapters of Part 4 of the SAR.

16.2 HOW AVOIDANCE IS DEFINED FOR THE PURPOSES OF THE STRATEGIC ASSESSMENT

There may be a range of reasons why land is avoided and not impacted under the Plan, including because land:

- Has high biodiversity values and is avoided for biodiversity purposes
- Is not strategically located and is therefore not a priority for development
- Is not generally suitable for development for another reason such as topography or land use conflict

To simplify the analysis in this chapter, avoidance is defined as any land that will not be impacted directly under the Plan. This land may occur in the Growth Areas, Strategic Assessment Area, or Study Area. Where it is possible to do so, avoidance decisions that were influenced by biodiversity are identified.

This chapter does not attempt to analyse how the Plan avoids and mitigates potential indirect impacts. These issues are addressed in Chapter 17.

16.3 STEPS TO AVOID AND MINIMISE IMPACTS

This section provides a summary of:

- The steps which have occurred to date to avoid impacts to protected matters
- The future processes that will be implemented to avoid and minimise impacts to protected matters

16.3.1 THE STEPS TAKEN TO DATE TO AVOID IMPACTS TO PROTECTED MATTERS

Avoidance has occurred in multiple stages and at multiple scales to date, including:

- Strategic planning to locate the Growth Areas
- Initial avoidance through preparation of the Framework Plan
- Evaluation of the Framework Plan and consideration of further avoidance as part of the Strategic Assessment Process

The avoidance process started at a landscape scale and informed the location of the Growth Areas. The process was undertaken through a range of regional and State scale processes. Relevant documents associated with this process include the G21 Regional Growth Plan (Geelong Region Alliance, 2013) and Plan Melbourne 2017–2050 (Victoria State Government, 2017).

This avoidance process involved considering a wide range of factors across the broader region, including:

- The locations and characteristics of landscape features including protected matters and environmental values
- The locations of existing development and infrastructure
- The overall suitability of the site for delivering development objectives

Once the location of the Growth Areas was determined, high level planning was completed through preparation of the Framework Plan (The City of Greater Geelong, 2021b). This process was based around urban development objectives and planning themes. Consideration of biodiversity values was one of the factors involved in planning decisions during this process. The Framework Plan includes a range of actions which will be implemented to avoid impacts to biodiversity in each of the Growth Areas.

When the Strategic Assessment process commenced, the City reviewed the avoidance priorities of the Framework Plan and confirmed that further avoidance was needed for the NGGA (in addition to the 82.3 ha identified in the Framework Plan) to better avoid impacts to MNES and native vegetation.

The City undertook a structured decision making (SDM) process in 2022 to determine the optimal layout of the NGGA (Gregory *et al.*, 2010). This layout was provided in the documents released for public exhibition in 2023.

Prior to exhibition of the documents, the Victorian Grassland Earless Dragon (VGED) (*Tympanocryptis pinguicolla*) was rediscovered in Victoria in January 2023 (noting the rediscovery was not publicly announced until after the process to commence the first round of public exhibition had started). Following rediscovery, detailed work was undertaken for the project including targeted surveys and detailed habitat assessments in the Growth Areas (Biosis, 2024b) and a habitat attribute analysis which used a range of analysis to understand the potential value of the NGGA for VGED (Biosis & Open Lines, 2024)

An additional SDM process was undertaken for the project in 2024 (see Supporting Document C). This process considered both the information collected during the VGED survey program and habitat attribute analysis, and community feedback from the first round of public exhibition. This SDM process focussed on the NGGA, although the initial phase identified that further avoidance was necessary within the WGGA. The Moorabool avoidance area was therefore incorporated into the Plan for the WGGA in addition to Cowies Creek Corridor and the Moorabool River Corridor.

To identify the optimal avoidance layout for the NGGA the SDM process considered three decision objectives and seven performance criteria. The decision objectives covered environmental, social, and economic issues and were:

1. Maximise the avoidance and protection of biodiversity
2. Maximise the supply of housing delivered in the precinct
3. Ensure the cost of the conservation program is feasible

Multiple different alternative layouts and scales of avoidance across the NGGA were evaluated against these objectives. The layout that performed best has been incorporated into the Plan as the Northern Conservation Area, Eastern Conservation Area and gully avoidance area.

16.3.2 FUTURE PROCESSES THAT WILL BE APPLIED TO AVOID AND MINIMISE IMPACTS TO PROTECTED MATTERS

A range of future processes will be applied to further avoid impacts to protected matters. These include:

- PSP processes for the precincts within the SAA
- Avoidance processes that will be applied within the portion of Heales Road East subject to process based development and to external infrastructure development outside of the Growth Areas

The PSP processes will provide an important opportunity to refine and confirm the boundaries of conservation areas, prepare Conservation Management Plans (CMPs) for conservation areas, and confirm the locations of any additional linear corridors for biodiversity linkages. Given the strategic process which has been undertaken for each of the Growth Areas, it is not expected that substantial further avoidance will occur as part of the PSP process.

The planning process for development within the portion of Heales Road East subject to process based development, and external infrastructure, will involve avoidance mechanisms to minimise impacts to protected matters. This will include site surveys to identify protected matters in potential development areas.

16.4 COMMITMENTS AND MEASURES FOR AVOIDANCE

The Plan has a range of commitments and measures for avoidance. A summary is provided here, while a detailed overview of commitments and measures for avoidance is in the BCS.

The Plan's commitments for avoidance relate to avoidance of species' habitat within the NGGA and the WGGA, the preparation and implementation of CMPs for avoided areas to protect environmental values, and the processes for development within the portion of Heales Road East subject to process based development and designing external infrastructure outside of the Growth Areas to avoid impacts to protected matters. These commitments are supported by a range of measures to deliver the commitments. Examples include measures to:

- Update the Framework Plan to show avoided areas as protected land and apply appropriate environmental zoning to avoided areas
- Acquire avoided land and vest the land in the City
- Fund the management of avoided areas
- Appropriately prepare CMPs in a manner which protects the protected matters located in each avoided area
- Undertake surveys for protected matters within external infrastructure footprints to enable avoidance of protected matters

16.5 AVOIDANCE OUTCOMES FOR MNES

This section presents the avoidance outcomes for MNES. It:

- Identifies the MNES that occur in the Strategic Assessment Area and Study Area that will be avoided entirely from being impacted directly
- Quantifies and analyses the avoidance outcomes for the MNES that will be subject to direct impacts
- Provides an overall conclusion about the avoidance outcomes

16.5.1 MNES THAT WILL BE AVOIDED ENTIRELY

There are a total of 31 Category 1 MNES that are assessed within this Strategic Assessment Report. Of these, 26 will not be subject to direct impacts. This is an outcome of the early strategic planning decisions in locating the Growth Areas.

Of the 26 Category 1 MNES which will not be subject to direct impacts:

- 5 have records and/or habitat within the Growth Areas (but not in developable land), Strategic Assessment Area, and Study Area
- 15 have records and/or habitat within the broader Strategic Assessment Area and Study Area
- 6 have habitat and/or records in the wider Study Area only

Table 16-1 identifies the MNES that will be avoided entirely from direct impacts under the Plan and indicates where each MNES is located.

It is noted that avoidance and protection of the Cowies Creek Conservation Area within WGGA will lead to the complete avoidance of direct impacts to the Growling Grass Frog (*Litoria raniformis*) and Adamson's Blown-grass (*Lachnagrostis adamsonii*). In addition, the Moorabool River within the WGGA supports suitable habitat for the three threatened fish species. Avoidance and protection of the riparian corridor of this waterway will help to minimise potential impacts to these species.

Further, future avoidance processes associated with the design of infrastructure outside of the Growth Areas (outlined above) will minimise potential direct impacts to protected matters which are present within the wider Strategic Assessment Area.

Further information regarding the avoidance outcomes for each of the protected matters identified above is provided in Part 4, Chapters 19, 20, 21 and 23.

Table 16-1: MNES that will be avoided entirely from being impacted directly by implementation of the Plan

MNES	MNES PRESENT IN:							
	NGGA		WGGA		SAA		STUDY AREA	
	R^	H^	R	H	R	H	R	H
Threatened fauna								
Australasian Bittern (*Botaurus poiciloptilus*)	No	No	No	No	No	Yes	Yes	Yes
Australian Fairy Tern (*Sternula nereis nereis*)	No	No	No	No	No	Yes	Yes	Yes
Australian Grayling (*Prototroctes maraena*)	No	No	No	Yes	No	Yes	Yes	Yes
Australian Painted Snipe (*Rostratula australis*)	No	No	No	No	No	Yes	Yes	Yes
Black-tailed Godwit (*Limosa limosa*)	No	No	No	No	No	Yes	Yes	Yes
Common Greenshank (*Tringa nebularia*)	No	No	No	No	No	Yes	Yes	Yes
Curlew Sandpiper (*Calidris ferruginea*)	No	No	No	No	No	Yes	Yes	Yes
Eastern Curlew (*Numenius madagascariensis*)	No	No	No	No	No	Yes	Yes	Yes
Great Knot (*Calidris tenuirostris*)	No	No	No	No	No	No	Yes	Yes
Greater Sand Plover (*Charadrius leschenaultii*)	No	No	No	No	No	Yes	Yes	Yes
Growling Grass Frog (*Litoria raniformis*)	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Latham's Snipe (*Gallinago hardwickii*)	No	No	No	No	No	Yes	Yes	Yes
Lesser Sand Plover (*Charadrius mongolus*)	No	No	No	No	No	Yes	Yes	Yes
Little Tern (*Sternula albifrons*)	No	No	No	No	No	Yes	Yes	Yes
Little Galaxias (*Galaxiella toourtkoourt*)	No	No	No	Yes	No	Yes	No	Yes
Orange-bellied Parrot (*Neophema chrysogaster*)	No	No	No	No	No	Yes	Yes	Yes
Red Knot (*Calidris canutus*)	No	No	No	No	No	Yes	Yes	Yes
Sharp-tailed Sandpiper (*Calidris acuminata*)	No	No	No	No	No	Yes	Yes	Yes
Western Alaskan Bar-tailed Godwit (*Limosa lapponica baueri*)	No	No	No	No	No	Yes	Yes	Yes
Yarra Pygmy Perch (*Nannoperca obscura*)	No	No	No	Yes	No	Yes	Yes	Yes
Threatened flora								
Adamson's Blown-grass (*Lachnagrostis adamsonii*)	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spiny Rice-flower (*Pimelea spinescens* subsp. *spinescens*)	No	No	No	No	Yes	Yes	Yes	Yes
Migratory species*								
Double-banded Plover (*Charadrius bicinctus*)	No	No	No	No	No	No	Yes	Yes
Marsh Sandpiper (*Tringa stagnatilis*)	No	No	No	No	No	No	Yes	Yes
Red-necked Stint (*Calidris ruficollis*)	No	No	No	No	No	No	Yes	Yes

MNES	MNES PRESENT IN:							
	NGGA		WGGA		SAA		STUDY AREA	
	R^	H^	R	H	R	H	R	H
Ramsar								
Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site	No		No		No		Yes	

* This list includes migratory species that are not listed as threatened. Any migratory species that are also threatened are identified under the "threatened species" section of the table

^ To save space, the following abbreviations have been used: R – Records, H – Habitat

16.5.2 AVOIDANCE OUTCOMES FOR MNES SUBJECT TO DIRECT IMPACTS

The following Category 1 MNES are subject to direct impacts under the Plan:

- Golden Sun Moth (*Synemon plana*) (GSM)
- Striped Legless Lizard (*Delma impar*) (SLL)
- Blue-winged Parrot (*Neophema chrysostoma*)
- Victorian Grassland Earless Dragon (*Tympanocryptis pinguicolla*) (VGED). Note that there will be direct impacts to grassland with potentially suitable habitat attributes for Victorian Grassland Earless Dragon, rather than known habitat for the species. Refer to the detailed impact assessment in Chapter 19 for further details
- Natural Temperate Grassland of the Victorian Volcanic Plain (Natural Temperate Grassland)

The avoidance of habitat for the GSM, SLL and VGED, and avoidance of areas of Natural Temperate Grassland, were key considerations during the SDM avoidance process for the NGGA as part of the strategic assessment process. The application of the SDM process resulted in the total avoidance area within the NGGA increasing by more than 67 ha compared to what was set out in the Framework Plan. The total area of avoidance within the NGGA is now just over 150 ha.

The specific avoidance outcomes for each of the above protected matters is as follows:

- GSM: A total of 124.1 ha of mapped habitat has been avoided for this species. Avoidance focused on areas where high densities of GSM have been recorded and where the largest remnants of native vegetation have been mapped. . In addition, the Plan provides an opportunity for habitat restoration in part of the Northern Conservation Area which is not currently mapped as habitat for GSM (550 Elcho Road)
- SLL: A total of 81.1 ha of mapped habitat has been avoided for this species. Avoidance focused on protecting two known populations of the species, the largest patch of confirmed habitat, and areas of mapped suitable habitat and potential modelled habitat within the NGGA. In addition, the Plan provides restoration opportunities to expand SLL habitat into the Eastern Conservation Area, and part of the Northern Conservation Area which is not currently mapped as habitat (550 Elcho Road)
- Natural Temperate Grassland: A total of 10.9 ha of the TEC has been avoided. This includes the largest contiguous patch of the TEC (6.7 ha) which will be protected and managed as an offset in the Eastern Conservation Area
- VGED: A total of 125.3 ha of potentially suitable areas for VGED have been avoided. Avoidance focused on the large, contiguous patch of grassland in the north of the NGGA
- Blue Winged Parrot. Habitat mapping is not available for this species. However, a total of 150.2 ha of native and introduced grassland which may provide potential foraging habitat for the species will be avoided within the NGGA

Further information regarding the avoidance outcomes for each of the protected matters identified above is provided in Part 4, Chapters 19 and 21.

16.5.3 CONCLUSION

A thorough avoidance process has been applied within the Strategic Assessment Area to minimise impacts to protected matters under the Plan. As a result, the vast majority of MNES within the Study Area will not be directly impacted under the Plan, with only five MNES subject to direct impacts. In relation to these, stringent avoidance processes have been applied to minimise potential impacts as far as is practicable.

Overall, it is considered that the avoidance process applied under the Plan is appropriate for protecting MNES while also enabling the necessary social and economic objectives to be addressed.

17 Managing indirect impacts

17.1 INTRODUCTION

This Chapter describes the mitigation measures that will be implemented under the Plan to avoid and minimise the indirect impacts of development. This information provides relevant context and background to support the detailed assessments for protected matters.

The information presented in this Chapter relates to the following ToR:

> *1.2. The Report must address how those impacts will be avoided, mitigated, and offset (where necessary or appropriate) to ensure the long-term protection of protected matters.*
>
> *…*
>
> *4.1. The Report must describe and assess the likely direct, indirect, and cumulative impacts of actions taken under the Plan on all relevant protected matters. This must include, but not necessarily be limited to, an assessment of impacts of clearing, disturbance and fragmentation*
>
> *…*
>
> *4.4. The Report must include analysis of:*
>
> *…*
>
> *b) the duration, extent, and likely severity of the impacts*
>
> *c) the mitigation measures that will be implemented and their likely effectiveness to reduce impacts on the protected matters…*
>
> *…*
>
> *4.6. The Report must consider the extent to which the impacts on relevant protected matters of actions proposed under the Plan would be consistent with the EPBC Act, including but not limited to:*
>
> *…*
>
> *b) how approving a class of actions to be taken in accordance with the Plan would not be inconsistent with recovery plans and threat abatement plans (section 146K(2) of the EPBC Act)*
>
> *c) how regard has been and will be given to relevant information in conservation advices (section 146K(3) of the EPBC Act), threat abatement plans and recovery plans*

The relevant potential impacts considered in this chapter have been identified and described in the assessment approach in Chapter 11 of Part 3 and include:

- Changes to water flows and quality
- Spread of infection and disease
- Spread of weeds
- Predation/ competition by pest/domestic fauna
- Altered fire regimes
- Disturbance from increased public access to natural areas
- Fauna mortality and barriers to movement
- Disturbance due to noise, dust or light
- Inadvertent impacts on adjacent habitat or vegetation

This chapter also describes the relevant Threat Abatement Plans (TAPs) to the Plan (also identified in Chapter 11 of Part 3), and assesses:

- Whether the Plan is not inconsistent with each TAP
- How regard has been given to information in each TAP

It is noted that detailed assessments of indirect impacts on specific protected matters is contained later within this Part, with threatened species assessed in Chapters 19 and 20, Threatened Ecological Communities assessed in Chapter 21, Ramsar wetlands assessed in Chapter 22, migratory species assessed in Chapter 23, and species listed on the FPAL assessed in Chapter 24.

17.1.1 PURPOSE

The purpose of this chapter is to:

- Describe how development under the Plan has the potential to introduce or exacerbate each indirect impact. This analysis takes into account the context and existing threatening processes in the Strategic Assessment Area and wider Study Area. As part of this step, the nature, extent, and duration of each indirect impact type has been described. This involved:
    - Nature of impacts – qualitatively describing each indirect impact type, including cause and scope of the impact
    - Extent of impacts – identifying the general location and extent of indirect impacts
    - Duration – identifying whether the impacts are short-term or long-term
- Identify the types of protected matters and associated values likely to be affected by each indirect impact within and surrounding the Strategic Assessment Area
- Describe the standard mitigation measures and processes that will be implemented through the existing Victorian planning system and the Geelong Planning Scheme to mitigate the indirect impacts
- Describe the additional, specific mitigation measures provided for under the Plan to address particular vulnerabilities or risks to MNES from indirect impacts

This information has enabled an evaluation of the adequacy of mitigation in appropriately addressing risks from indirect impacts on MNES as part of the detailed assessments for relevant matters presented in Chapters 19-24.

17.2 ANALYSIS OF INDIRECT IMPACTS

17.2.1 CHANGES TO WATER FLOWS AND QUALITY

NATURE OF EXISTING THREAT IN REGION

There are several aquatic systems within the Study Area which are downstream of the Growth Areas, including Cowies Creek, Hovells Creek and the Moorabool River (which discharges into the Barwon River and then the Lake Connewarre Complex).

These systems provide some important ecological processes and functions. For instance, by supporting habitat for a number of threatened species or as tributaries into internationally significant wetland areas. However, all of these systems also have substantial existing degradation. In 2010, the state-wide Index of Stream Condition found that Hovells Creek, the Moorabool River and the Barwon River were in 'very poor' environmental condition (the lowest environmental condition category in the rating system) (Corangamite CMA, 2014). Contributors to the poor condition of these waterways include agricultural and urban development within the catchments. Cowies Creek is also subject to substantial agricultural and urban development within its catchment.

POTENTIAL IMPACT PATHWAYS ASSOCIATED WITH DEVELOPMENT UNDER THE PLAN AND IDENTIFICATION OF MATTERS OR AREAS OF CONCERN

The Plan has the potential to negatively impact upon aquatic environmental values through altering runoff volumes, timing, and water quality due to development. These impacts are likely to occur during both the short-term construction and long-term operational phases of development.

Cowies Creek, Hovells Creek, the Moorabool River, and the Barwon River all support important and sensitive environmental values protected under the EPBC Act. Cowies Creek is located downstream of both Growth Areas and supports habitat for the EPBC-listed Growling Grass Frog and for Adamson's Blown-grass. Hovells Creek drains into Limeburners Bay, which is part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site. The Moorabool River discharges into the Barwon River, which in turn discharges into the Lake Connewarre Complex, which is also part of the Ramsar site. The Ramsar site supports habitat for multiple threatened and migratory species protected under the EPBC Act.

EXISTING STANDARD MITIGATION MEASURES

The planning system has existing measures in place to address changes to water flows and quality.

The Geelong Planning Scheme includes objectives and strategies to:

- Ensure land use on floodplains minimises the risk of waterway contamination during flooding (Clause 13.03-1S)
- Prevent inappropriate development in areas prone to erosion (Clause 13.04-1S)
- Retain natural drainage corridors, minimise runoff volume from developed areas, filter sediment and waste from stormwater prior to discharge, ensure land use and development minimises nutrient contributions to runoff, and implement measures to minimise sediment discharge from construction sites (Clause 14.02-1S)
- Minimise impacts to water quality through ensuring that land uses which have potential to produce contaminated runoff are appropriately sited and managed (Clause 14.02-2S)
- Implement integrated water management to sustainably manage water supply and demand, water resources, wastewater, drainage, and stormwater (Clause 19.03-3S)

The Geelong Planning Scheme also includes a range of requirements to ensure stormwater management meets appropriate objectives and standards, including objectives for stormwater quality (for example, see Clause 53.18).

The Plan includes a commitment to continue to implement these standard mitigation measures to manage the indirect impacts of the development in accordance with the requirements of the Geelong Planning Scheme (Commitment 13).

The NWGGA Framework Plan also includes various mitigation-related actions to address water flows and quality, including implementation of riparian buffers, and the preparation of masterplans for Cowies Creek and Barwon and Moorabool rivers for integrated water management.

ADDITIONAL MEASURES TO ADDRESS INDIRECT IMPACTS TO MNES

The existing standard mitigation measures minimise potential indirect impacts associated with altered water flows and quality. However, these measures are general in nature, and it is not well established whether they will adequately address the particular ecological characteristics or requirements of the downstream MNES values associated with these catchments.

To address this, the Plan includes a specific Commitment (Commitment 15) to minimise the indirect impacts of the development on protected matters. The measures relevant to water flow and quality that will be undertaken to deliver on this Commitment include:

- Undertaking relevant technical studies to understand the key risks from development on protected matters associated with Hovells Creek and the Moorabool River. These studies will:
    - Address potential risks associated with changes to water quality and hydrology as a result of development within the Growth Areas
    - Identify appropriate measures, standards or targets to avoid and minimise adverse impacts on protected matters including, as relevant:
    - Water quality parameters
    - Water retention and flow management requirements
    - Limits on extraction or use
    - Habitat buffer requirements
    - Monitoring and reporting
- Preparing guidelines based on the results of the technical studies to guide the preparation of PSPs and decisions on planning permits and permit conditions to ensure risks to protected matters in relation to indirect and downstream impacts are adequately managed
- Undertaking a planning scheme amendment or other appropriate process to ensure the guidelines are considered during the preparation of PSPs and in decisions on planning permits and permit conditions

The Commitment (Commitment 15) will be implemented prior to the preparation of PSPs for the relevant precincts.

17.2.2 SPREAD OF INFECTION/DISEASE

NATURE OF EXISTING THREAT IN REGION

The Plan has the potential to increase the spread of infection and disease through development (Bradley and Altizer, 2007). These impacts are likely to occur during both the short-term construction and long-term operational phases of development.

It is possible that there is already a high prevalence of environmental diseases within the region, given existing development within the Geelong locality.

An assessment has been conducted to identify the Category 1 protected matters within the Geelong locality which are threatened by disease, and to identify the relevant diseases. This assessment has identified the following relevant diseases:

- Chytridiomycosis – affecting the Growling Grass Frog
- Psittacine beak and feather disease (PBFD) – affecting the Orange-bellied Parrot and Blue-winged Parrot
- Avian influenza virus – affecting bird species including the Red Knot and Great Knot
- Various aquatic pathogens, including parasites, viruses and fungi – affecting the Australian Grayling

These diseases are widespread across Australia, and it is possible that they are present within the Geelong region.

POTENTIAL IMPACT PATHWAYS ASSOCIATED WITH DEVELOPMENT UNDER THE PLAN AND IDENTIFICATION OF MATTERS OR AREAS OF CONCERN

At a local scale, the Plan has the potential to increase the spread of pathogens within the Strategic Assessment Area through increased movement of materials and people within developed areas, and through increased environmental degradation at development boundaries. The increased risk of disease transmission is likely to be long term, occurring during both the construction and operational stages of development. Areas of risk are those in proximity to the areas of development within the Growth Areas and in areas of infrastructure development outside of the Growth Areas. It is recognised that these areas are already developed and degraded, and subsequently elevated disease transmission is likely to be an existing threat. To minimise the risks of further increases to disease transmission, standard mitigation measures within the planning system will be applied (outlined below).

The Plan may have some potential to increase the risk of disease transmission at a landscape scale, through increased movement of people through the wider area, particularly relating to increased visitation of natural areas in the region. However, given that the Geelong locality already has high visitation rates within its natural areas (due to its existing urban population, and as a popular recreational destination), this threat is an existing landscape threat. It is unlikely that the Plan will substantially exacerbate this threat.

EXISTING STANDARD MITIGATION MEASURES

The planning system has existing general measures in place to address the spread of infection/disease from development. This includes a broad requirement for decision-making to account for the impacts of development on the spread of pathogens (Clause 12.01-1S) and a requirement for subdivision applications to describe how the site will be managed prior to and during construction to protect the site and surrounding area from environmental degradation (Clause 56.08). The preparation of Construction Environmental Management Plans prior to the commencement of construction is included in the City's template of standard conditions, which will be applied by the City as a permit condition where it is considered appropriate.

ADDITIONAL MEASURES TO ADDRESS INDIRECT IMPACTS TO MNES

These existing, standard measures are considered adequate in addressing the potential indirect impacts of development on protected matters in relation to the spread of pathogens.

17.2.3 SPREAD OF WEEDS

NATURE OF EXISTING THREAT IN REGION

Weeds are a substantial existing threat within the Strategic Assessment Area. Surveys conducted within the NWGGA found that vegetation on site is highly modified and dominated by non-indigenous grasses (i.e. pasture grasses) and weeds, and that areas of native vegetation are largely confined to riparian corridors. Nine species were identified within

the NWGGA that are declared noxious weeds under the Victorian *Catchment and Land Protection Act 1994*, including: *Nassella neesiana* (Chilean Needle-grass), *Juncus acutus* (Spiny Rush), *Lycium ferocissimum* (African Box-thorn), *Cirsium vulgare* (Spear Thistle), *Cynara cardunculus* (Artichoke Thistle), *Echium plantagineum* (Patterson's Curse), *Nassella trichotoma* (Serrated Tussock), *Rosa rubignosa* (Sweet Briar) and *Xanthium spinosum* (Bathurst Burr) (EHP, 2021).

Weeds are also an existing threat within the wider Study Area. For instance, salt tolerant weeds within the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site pose a threat to saltmarsh and waterbird habitat (DELWP, 2020).

The abundance of weeds in the region is due to high existing development pressures, including agricultural and urban development.

POTENTIAL IMPACT PATHWAYS ASSOCIATED WITH DEVELOPMENT UNDER THE PLAN AND IDENTIFICATION OF MATTERS OR AREAS OF CONCERN

Generally speaking, development often has the potential to increase the spread and proliferation of weeds. One mechanism by which development can result in the spread of weeds is through the increased movement of people and materials. This may lead to plant seeds, spores or material being transported from one site to another. Typically, weed proliferation due to development occurs when weed matter is transported from an area of high weed density to a site with a low density of weeds. However, the high levels of existing weeds within the Strategic Assessment Area and more broadly, mean that development under the Plan is unlikely to result in the introduction of novel weed species into otherwise weed-free areas.

Development may also encourage weed invasion by degrading environments adjacent to development in a manner which promotes weed proliferation (for example, through nutrient enrichment). However, land within the Strategic Assessment Area is already substantially modified (largely due to agricultural development) and already has landscape processes in place which encourage weed growth (for example, through agricultural fertiliser application). For this reason, the landscape is already considered to be disturbed. It is unlikely that development under the Plan will exacerbate the risk of weed invasion due to habitat disturbance.

Altogether, the characteristics of the Strategic Assessment Area, including its existing high levels of weed density and disturbance, are such that it is unlikely that the Plan would exacerbate the existing level of threat posed by weeds in the region.

EXISTING STANDARD MITIGATION MEASURES

The planning system has existing general measures in place to address the spread of weeds from development. This includes a broad requirement for decision-making to account for the impacts of development on the spread of weeds (Clause 12.01-1S) and a requirement for subdivision applications to describe how the site will be managed prior to and during construction to protect the site and surrounding area from environmental degradation (Clause 56.08). The preparation of Weed Management Plans prior to the commencement of construction is included in the City's template of standard conditions, which will be applied by the City as a permit condition where considered appropriate.

ADDITIONAL MEASURES TO ADDRESS INDIRECT IMPACTS TO MNES

These existing, standard measures are considered adequate in addressing the potential indirect impacts of development on protected matters in relation to the spread of weeds.

17.2.4 PREDATION/COMPETITION BY PEST/DOMESTIC FAUNA

NATURE OF EXISTING THREAT IN REGION

Pest animals are an existing threat within the region. There is evidence the NWGGA is occupied by rabbits, hares and foxes (EHP, 2021). Additionally, foxes, cats, rabbits, deer are identified as invasive species of concern at the Port Phillip Bay (Western Shoreline) & Bellarine Peninsula Ramsar site (DELWP, 2020). Other invasive fauna, such as rats, pigs, and goats, are also likely to be present in the wider area.

There is substantial existing development within the Geelong region, including urban and agricultural development. This existing development is likely to be contributing to a high density of invasive pests in the region.

POTENTIAL IMPACT PATHWAYS ASSOCIATED WITH DEVELOPMENT UNDER THE PLAN AND IDENTIFICATION OF MATTERS OR AREAS OF CONCERN

The Plan will result in establishment of new urban areas within the Strategic Assessment Area. Urban environments are widely recognised to be associated with higher densities of invasive fauna. Although the exact mechanisms for this are not well understood, possible mechanisms include (Gaertner *et al.*, 2017):

- Alteration of environmental features within and adjacent to urban environments such that native species are not well adapted to the environment, which can result in native species being more easily outcompeted. It is noted that habitat within the Strategic Assessment Area is already substantially altered from its natural state due to existing agricultural and residential development and has a high density of invasive flora. Subsequently, this is an existing threat, although development under the Plan may further exacerbate this threat
- Increased movement of people, vehicles, and material, which facilitates dispersal via transport vectors. The Strategic Assessment Area already has regular movements associated with existing development in the area. This is considered an existing threat which the Plan has potential to exacerbate through increasing the population density within the Strategic Assessment Area
- Urban environments acting as foci for the entry of invasive species/introduction of new species in the environment. As there is substantial existing urban development within the wider Geelong locality, this is considered an existing landscape threat within the Geelong region. It is unlikely that development under the Plan would substantially exacerbate this threat
- Urban areas supporting higher densities of domestic fauna which pose a threat to native species (such as cats and dogs). While domestic fauna are an existing threat within the Strategic Assessment Area associated with existing development, it is recognised that the Plan is likely to exacerbate this threat within and in proximity to urban development within the Growth Areas

EXISTING STANDARD MITIGATION MEASURES

The planning system has existing standard mitigation measures in place to address the potential increase and spread of pest animals from development. This includes a broad requirement for decision-making to account for the impacts of development associated with pest animals (Clause 12.01-1S) and a requirement for subdivision applications to describe how the site will be managed prior to and during construction to protect the site and surrounding area from environmental degradation (Clause 56.08).

The NWGGA Framework Plan also includes several mitigation-related actions relevant to managing pest animals. These mitigation-related actions will be further considered and given effect within each precinct as appropriate through the preparation of PSPs, which will be prepared in consideration of the Framework Plan. These measures are considered adequate to address the potential increase and spread of pest animals from the development.

Further, the City of Greater Geelong has a Domestic Animal Management Plan in place. This plan identifies how Council protects the environment and local wildlife from the negative impacts from dogs and cats. It includes a range of measures including dog control orders to protect wildlife and the environment (particularly in coastal areas), in addition to a cat curfew order (which requires that cats are confined from sunset to sunrise) (The City of Greater Geelong, 2022c).

ADDITIONAL MEASURES TO ADDRESS INDIRECT IMPACTS TO MNES

These existing measures are considered adequate in addressing the potential indirect impacts of development on protected matters in relation to predation or competition by pest or domestic fauna.

17.2.5 ALTERED FIRE REGIMES

NATURE OF EXISTING THREAT IN REGION

Native ecosystems within the Strategic Assessment Area require periodic fire to maintain long term biodiversity. Absence of fire, or fires that are too frequent or intense, can have a negative impact on ecosystems through altering plant species assemblages (which affects habitat and foraging resources), or through fauna mortality.

Fire regimes in the Strategic Assessment Area, as well as across the wider Study Area, are already substantially modified due to existing development. Altered fire regimes are therefore considered an existing landscape threat.

POTENTIAL IMPACT PATHWAYS ASSOCIATED WITH DEVELOPMENT UNDER THE PLAN AND IDENTIFICATION OF MATTERS OR AREAS OF CONCERN

Altered fire regimes due to development under the Plan may be caused by:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation

The threat of altered fire regimes is a long-term threat, occurring during both construction and operational phases of the development.

The areas which are most likely to be impacted are those which are in proximity to areas of development within the Growth Areas, and areas of infrastructure development outside of the Growth Areas. It is recognised that these areas already experience altered fire regimes due to existing disturbance. Subsequently, altered fire regimes are considered an existing threat. Although the development of new urban areas adjacent to newly established conservation areas in the NGGA and WGGA presents a set of issues relating to fire regimes that will need to be managed to protect the relevant MNES values.

EXISTING STANDARD MITIGATION MEASURES

The planning system has existing standard mitigation measures in place to address the risk of altered fire regimes and increased fire risk from development. This includes a broad requirement to ensure development can implement bushfire protection measures without unacceptable impacts to biodiversity through appropriate planning (Clause 13.02-1S). The Plan includes a commitment to continue to implement these standard mitigation measures to manage the indirect impacts of the development in accordance with the requirements of the Geelong Planning Scheme (Commitment 13).

ADDITIONAL MEASURES TO ADDRESS INDIRECT IMPACTS TO MNES

The Plan includes a commitment to implement several specific mitigation measures to address the indirect impacts of the development on the Northern Conservation Area, the Eastern Conservation Area, and the Cowies Creek Conservation Area, including establishing a conservation interface between urban development and these areas. The Plan also includes a commitment to prepare and implement a Conservation Management Plan for these areas that will provide for appropriate fire management to protect biodiversity values. These commitments will contribute to the protection of biodiversity values from impacts associated with inappropriate fire regimes.

17.2.6 DISTURBANCE FROM INCREASED PUBLIC ACCESS TO NATURAL AREAS

NATURE OF EXISTING THREAT IN REGION

Many of the publicly available natural areas in the Geelong region experience high visitation rates. Geelong already supports a substantial urban population and is also a popular tourist and recreational destination. Many of the natural areas, including nature reserves and coastal areas, are already developed and managed to support high volumes of recreational access. Disturbance from public access to natural areas is therefore an existing threat in the region.

POTENTIAL IMPACT PATHWAYS ASSOCIATED WITH DEVELOPMENT UNDER THE PLAN AND IDENTIFICATION OF MATTERS OR AREAS OF CONCERN

Development under the Plan will increase human activity within the Strategic Assessment Area and the surrounding region, through increasing the overall population of the area. This will increase the threat of disturbance from public access to natural areas. Areas which are most at risk are those within or in proximity to the Strategic Assessment Area, and those which are highly accessible within the region and/or which constitute a main attraction (such as popular beaches).

The threat of increased disturbance due to development under the Plan is long term and is associated with population density. For this reason, the risk will be minimal in the early stages of Plan implementation, and then will gradually increase over the life of the Plan as more urban development is completed and progressively occupied.

The impacts to protected matters from this threat due to development under the Plan is unlikely to be substantial. This is because natural areas within the Study Area already experience high visitation rates, associated with the existing population of the region and high visitor numbers. In the context of the scale of the existing threat in the region, the overall impact of the Plan is expected to be minimal.

It is also noted that this threat is relevant to the strategic conservation areas under the Plan, including the Northern and Eastern Conservation areas. These areas will be managed through Conservation Management Plans to protect and enhance the relevant biodiversity values. Threats associated with disturbance in these areas will be managed through this process.

A range of existing management measures are in place in the planning system which will help to mitigate this threat.

EXISTING STANDARD MITIGATION MEASURES

There are a number of reserves within the wider Geelong locality which support records and/or habitat for multiple protected matters. These include Limeburners Lagoon Flora and Fauna Reserve, Lake Connewarre Wildlife Reserve, The Spit Wildlife Reserve, and Breamlea Flora and Fauna Reserve. Each of these reserves is managed by Parks Victoria to protect and enhance flora and fauna values while supporting appropriate community use. Refer to Table 17-1 for further information on the characteristics of each reserve and existing management measures in place.

In addition to these reserves, there is also a region at Moolap which is managed for conservation purposes under the Moolap Coastal Strategic Framework Plan. This site also supports habitat and records of multiple protected matters, including threatened and migratory birds. Refer to Table 17-1 for further information.

Further, there are existing management frameworks to manage the impacts of domestic dogs in coastal environments. State-appointed independent land management authorities are responsible for large areas of coastline around the Bellarine Peninsula. These authorities develop dog orders for these coastal areas. Geelong City Council is then responsible for patrolling and enforcing dog orders. Dog orders include seasonal dog orders to protect endangered wildlife and coastal nesting birds (The City of Greater Geelong, 2022c).

Table 17-1: Sites within the Geelong region with existing management in place to minimise human disturbance

Site	Site location and description	Existing management
Limeburners Lagoon Flora and Fauna Reserve	This reserve is located within Limeburners Bay and is part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. It is part of a broad, sandy estuarine inlet, with shallow tidal water. The inlet supports shoreline, sandy spit and seagrass environments.	This reserve is managed in partnership by the City and Parks Victoria. The following are not permitted: dogs, cats, other pets, horses, bicycles, fires, firearms, and vehicles (excluding management vehicles). (Parks Victoria, 2022c)
Lake Connewarre Wildlife Reserve	This reserve is located within the Lake Connewarre Complex and is part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. It is a large, shallow estuarine lagoon, and contains a diverse range of wetlands and vegetation including mangroves and saltmarsh communities.	This reserve is managed by Parks Victoria. The reserve is large and has variable restrictions in different areas of the reserve. Dogs are permitted on a leash in some locations and are prohibited in other areas. The following are prohibited in some areas, yet permitted in other areas: horses, vehicles (excluding management vehicles), firearms, camping, and generators. Fires are prohibited and boating zones apply throughout the reserve. (Parks Victoria, 2022e, 2022c, 2022d, 2022g, 2022a)
The Spit Wildlife Reserve	This reserve is located within the Port Wilson area and is part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. It contains sand spits, a lagoon, mudflats and areas of saltmarsh.	This reserve is managed by Parks Victoria. Public access to this reserve is partially restricted. At publicly accessible sites, dogs and vehicles (excluding management vehicles) are prohibited. Boating zones also apply (Parks Victoria, 2022h). Public access to some areas of the reserve is restricted and require a permit from Melbourne Water as the site is adjacent to the Werribee Sewage Farm (Conservation Volunteers Australia, 2022).

Site	Site location and description	Existing management
Breamlea Flora and Fauna Reserve	This reserve is located in the south of the Study Area associated with Thompson Creek. It supports saltmarshes and coastal dune environments.	This reserve is managed by Parks Victoria (The Breamlea Association, 2016). Dogs are not permitted within the reserve (The Breamlea Association, 2016).
'Wetlands and Former Saltworks Precinct' within the Moolap Coastal Strategic Framework Plan	The Moolap Coastal Strategic Plan outlines the management objectives and strategies for the Moolap area. The area covered by the Strategic Plan includes the Moolap IBA, in addition to areas of land outside of the IBA. The majority of the Moolap IBA is located in the 'Wetlands and Former Saltworks Precinct' of the Strategic Plan. The area includes salt pans separated by bunds (from a former saltworks) which is used as a feeding location by many migratory birds. Seagrass meadows occur in the shallow bay area adjacent to the salt bunds.	The overarching goal for the Precinct is that the area be managed and coordinated to prioritise environmental outcomes and to respond to existing values and risks. With regards to disturbance management, the Strategic Plan contains a range of strategies, including: • Facilitating while managing public access to enable recreation and passive enjoyment of the area while conserving environmental values • Avoiding and managing risks of domestic animals entering conservation areas • Avoiding boating and marine infrastructure where it would impact ecological values (DELWP, 2019)

ADDITIONAL MEASURES TO ADDRESS INDIRECT IMPACTS TO MNES

These existing measures are considered adequate in addressing the potential indirect impacts of development on protected matters in relation to disturbance from increased public access to natural areas.

17.2.7 FAUNA MORTALITY AND BARRIERS TO MOVEMENT

NATURE OF EXISTING THREAT IN REGION

Roads and traffic can result in mortality through vehicle strikes. There are multiple existing roads within and adjacent to the Strategic Assessment Area. The busiest road is Geelong Ring Road, a dual carriageway road which occurs along the southern boundary of NGGA and eastern boundary of WGGA. Other roads include highways and main roads which link rural centres in the wider region, and local roads which provide access to existing agricultural enterprises and residences. Traffic also occurs off public roads on agricultural land within the Strategic Assessment Area. Overall, fauna mortality from vehicle strike is an existing threat within the Strategic Assessment Area.

Roads and other linear structures such as fences and railways may also pose a threat to fauna by affecting fauna movements, either through preventing fauna movements or through discouraging fauna use of habitat due to disturbance. As outlined above, the Strategic Assessment Area already contains multiple roads. Fences are a further existing threat associated with existing agricultural land uses of the area. Overall, linear infrastructure that affects fauna movement is considered an existing threat within the Strategic Assessment Area.

Structures may cause fauna mortality. Examples include mortality from bird collisions with windows, or animals drowning in backyard pools. The Strategic Assessment Area includes existing agricultural and residential structures at a variable but mostly low density. This is therefore an existing threat within the Strategic Assessment Area. This threat is also present with greater severity in the wider landscape, particularly associated with existing urban, commercial, and industrial areas of Geelong.

Mortality may also occur due to secondary poisoning associated with pest control. This is an existing threat within the Strategic Assessment Area, primarily associated with existing agricultural land uses.

POTENTIAL IMPACT PATHWAYS ASSOCIATED WITH DEVELOPMENT UNDER THE PLAN AND IDENTIFICATION OF MATTERS OR AREAS OF CONCERN

Development under the Plan may increase the risk of fauna mortality associated with vehicle strikes within the Strategic Assessment Area. While this is an existing threat within the Strategic Assessment Area, the Plan will result in an increase in traffic density within this area associated with population density increases. The threat of fauna mortality associated with vehicle strikes under the Plan is a long-term threat and will gradually increase over the life of the Plan as the

Growth Areas are developed and occupied. The areas which are of most concern with regards to vehicle strike are those in proximity to the NGGA and Cowies Creek Conservation Areas that will be established under the Plan.

It is unlikely that the Plan would result in an increased threat of vehicle strikes within the wider Study Area. This is because there is already a high traffic density associated with the large existing population of Geelong, combined with the large numbers of visitors to the region.

The Plan has the potential to exacerbate impacts to fauna movement by linear infrastructure within the Strategic Assessment Area by increasing the level of disturbance associated with existing linear infrastructure (e.g. through increasing traffic density on existing roads).

Impacts to fauna movement from linear infrastructure will occur over the long term and will gradually increase under the Plan as development progresses. Key areas of impact are areas of infrastructure development outside of the Growth Areas. It is unlikely that the Plan will exacerbate this threat across the wider Study Area given the existing high population density of the region and the existing levels of infrastructure development.

It is unlikely that the Plan would substantially increase the threat of mortality posed by new structures. This is because there is already a high density of similar development within the wider landscape. Further, none of the protected matters potentially impacted by the Plan are known to be threatened by mortality associated with the types of structures which will be constructed under the Plan.

It is also unlikely that the Plan would exacerbate the existing threat of mortality from secondary poisoning due to pest control. Given that the Strategic Assessment Area contains predominantly agricultural land, the use of chemical pest control in this area is considered an existing threat.

EXISTING STANDARD MITIGATION MEASURES

The planning system has existing standard mitigation measures in place to address the risk of fauna mortality and barriers to movement from development. This includes a broad requirement that decision-making account for the impacts of development on fragmentation of habitat and assist in the establishment and protection of links between important areas of biodiversity (Clause 21.05-3).

The NWGGA Framework Plan also includes several mitigation-related actions relevant to addressing barriers to movement, including establishing the habitat corridors shown in Plan 9 and Plan 17 of the framework plan and establishing riparian reserves shown in Plan 7 of the framework plan. These mitigation-related actions will be further considered and given effect within each precinct as appropriate through the preparation of PSPs, which will be prepared in consideration of the framework plan.

ADDITIONAL MEASURES TO ADDRESS INDIRECT IMPACTS TO MNES

These existing measures are considered adequate in addressing the potential indirect impacts of development on protected matters in relation to fauna mortality and barriers to movement.

17.2.8 DISTURBANCE DUE TO NOISE, DUST, OR LIGHT

NATURE OF EXISTING THREAT IN REGION

Noise pollution is an existing yet variable threat across the Strategic Assessment Area. The Strategic Assessment Area mostly comprises agricultural land. Agricultural areas are generally quiet, although agricultural activities (such as operation of machinery or livestock management) have potential to produce sporadic noise.

Existing noise pollution is a greater threat in the south-east of the Strategic Assessment Area, associated with existing urban and residential development, and with major roads (such as Geelong Ring Road). In these areas, noise pollution is a more constant feature of the environment associated with current land uses. Noise pollution is also recognised as an existing threat in the wider region, primarily associated with existing urban, commercial and industrial development within Geelong.

Dust is an existing threat within the Strategic Assessment Area due to agricultural practices. Agricultural activities within the Strategic Assessment Area have the potential to produce dust pollution in multiple ways. Examples include:

- Reducing vegetation cover (via cropping or grazing)
- Soil disturbance (e.g. via ploughing or earthworks)

- Processing or moving agricultural produce (such as grain)
- Movement of vehicles on unsealed farm roads

Potential dust pollution within the Strategic Assessment is a variable threat, with the risk of dust increased during periods of drought.

There is some existing light pollution within the Strategic Assessment Area. Most of the Strategic Assessment Area comprises agricultural land, which generally has limited light production. Instead, light pollution is primarily associated with urban environments and busy roads in the south-east of the Strategic Assessment Area. In the wider Study Area, the city of Geelong produces substantial light pollution due to its wide areas of urban development.

POTENTIAL IMPACT PATHWAYS ASSOCIATED WITH DEVELOPMENT UNDER THE PLAN AND IDENTIFICATION OF MATTERS OR AREAS OF CONCERN

Development under the Plan will result in increased noise pollution within the Strategic Assessment Area. The areas most at risk include areas adjacent to development within the Growth Areas, and infrastructure development outside the Growth Areas where infrastructure is noise generating (such as new roads). Increased noise pollution will be long term and will occur during both the construction and operational stages of development.

However, the consequence of increased noise pollution within the Strategic Assessment Area will not be substantial. Firstly, noise pollution is an existing threat within the Strategic Assessment Area, as well as in the wider Study Area. Development under the Plan will therefore not result in the introduction of a novel threat to the region. Further, none of the protected matters which occur within the Strategic Assessment Area have noise pollution identified as a known threat. The potential for increased noise pollution under the Plan to negatively impact protected matters is therefore minimal.

Development under the Plan will not increase the risk of dust pollution. Dust pollution is considered a substantial existing threat within the Strategic Assessment Area due to agricultural activities. The Plan may result in dust production during the construction phases of development, and it will be important that CEMPs appropriately mitigate this risk. Further, the operational phase of the Plan is likely to result in an overall decrease in dust production, as an increase in hard surfaces within the Growth Areas would substantially reduce the area of exposed soil from which dust could be produced.

The Plan will increase light pollution within the Strategic Assessment Area at a local scale. The impact of increased lighting under the Plan will be long term.

There are multiple protected matters that occur within the Study Area which have potential to be impacted by light pollution at a landscape scale. Specifically, movement patters of migratory species protected under the EPBC Act can be affected by artificial light sources during migration. However, at a landscape scale, light pollution is an existing threat within the Study Area, and it is unlikely that the Plan would exacerbate this threat.

EXISTING STANDARD MITIGATION MEASURES

The planning system has existing standard mitigation measures in place to address the potential impacts from noise, dust and light from development on fauna. This includes a requirement for subdivision applications to describe how the site will be managed prior to and during construction to protect the site and surrounding area from environmental degradation (Clause 56.08). The preparation of Construction Environmental Management Plans prior to the commencement of construction is included in the City's template of standard conditions, which will be applied by the City as a permit condition on development where appropriate. The Plan includes a commitment to continue to implement these standard mitigation measures to manage the indirect impacts of the development in accordance with the requirements of the Geelong Planning Scheme (Commitment 13).

ADDITIONAL MEASURES TO ADDRESS INDIRECT IMPACTS TO MNES

The Plan includes a commitment to implement specific mitigation measures to address the indirect impacts associated with light on Cowies Creek Conservation Area. This commitment requires public lighting to be baffled and designed to prevent light spill and glare within the Cowies Creek Conservation Area. The Plan also includes commitments to prepare and implement a Conservation Management Plans for the two NGGA conservation areas and Cowies Creek Conservation Area. Where existing mitigation measures (implemented under Commitment 13, described above) are not adequate, the Conservation Management Plans will provide for additional management of noise, dust and light as required to protect biodiversity values.

17.2.9 INADVERTENT IMPACTS ON ADJACENT HABITAT OR VEGETATION

NATURE OF EXISTING THREAT IN REGION

The Strategic Assessment Area is currently subjected to regular disturbance. This is primarily associated with agricultural activities, but also includes disturbance associated with residential areas, and maintenance of infrastructure such as roads. This existing disturbance has led to the degradation of environmental values within the Strategic Assessment Area, including lowered native biodiversity and simplified vegetation structure.

POTENTIAL IMPACT PATHWAYS ASSOCIATED WITH DEVELOPMENT UNDER THE PLAN AND IDENTIFICATION OF MATTERS OR AREAS OF CONCERN

The Plan has the potential to cause inadvertent impacts to habitat or vegetation adjacent to development sites. This threat is primarily a short-term threat during the construction phase of the development, yet also may occur in the long term at smaller site scales during the operational phase of the development as infrastructure and dwellings are sporadically modified or upgraded. This threat is most relevant to the NGGA and Cowies Creek conservation areas that will be established under the Plan, as well as to areas adjacent to infrastructure development outside of the Growth Areas.

The consequence of these potential impacts is reduced by the existing degradation within the Strategic Assessment Area, caused by existing development and associated disturbance regimes. Therefore, it is unlikely that potential inadvertent impacts to adjacent habitat or vegetation caused by the Plan would substantially exacerbate the existing level of threat to protected matters.

EXISTING STANDARD MITIGATION MEASURES

The planning system has existing general measures in place to address inadvertent impacts on adjacent habitat or vegetation. This includes a requirement for subdivision applications to describe how the site will be managed prior to and during construction to protect the site and surrounding area from environmental degradation (Clause 56.08). The preparation of Construction Environmental Management Plans prior to the commencement of construction and a requirement to clearly mark all vegetation to be retained at the site are included in the City's template of standard conditions, which will be applied by the City as a permit condition where considered appropriate.

ADDITIONAL MEASURES TO ADDRESS INDIRECT IMPACTS TO MNES

These existing measures are considered adequate in addressing the potential indirect impacts of development on protected matters in relation to inadvertent impacts to adjacent habitat or vegetation.

17.3 ANALYSIS OF THREAT ABATEMENT PLANS

17.3.1 INTRODUCTION

Threat Abatement Plans (TAPs) have been developed under the EPBC Act to address listed Key Threatening Processes (KTPs) and include actions to reduce their impact on threatened species and TECs.

Under section 4.6(b) of the ToR for this strategic assessment and under section 146K(2) of the EPBC Act, the impact assessment should address whether the actions under the Plan are inconsistent with any approved Threat Abatement Plans (TAPs).

Under section 4.6(c) of the ToR, the impact assessment must also consider how regard has been and will be given to relevant information in the TAPs.

The KTPs and TAPs which are potentially relevant to the Plan are identified in Section 17.3.2. Analysis of each of the relevant TAPs is then presented in Section 17.3.3 through to Section 17.3.8.

17.3.2 IDENTIFICATION OF RELEVANT EPBC KEY THREATENING PROCESSES AND THREAT ABATEMENT PLANS

Each of the possible impacts related to implementation of the Plan has been considered with regards to KTPs identified under the EPBC Act. All KTPs potentially associated with impacts under the Plan are identified in Table 17-2. TAPs which are associated with the potentially relevant KTPs are identified in Table 17-3.

Table 17-2: Key Threatening Processes (KTPs) associated with potential impacts under the Plan

Impact type	Impact sub-category	Relevant KTP listed under the EPBC Act
Direct impacts	-	• Land clearance
Indirect impacts	Water flows and quality	-
	Spread of infection/disease	• Infection of amphibians with chytrid fungus resulting in chytridiomycosis • Novel biota and their impact on biodiversity
	Spread of weeds	• Loss and degradation of native plant and animal habitat by invasion of escaped garden plants • Novel biota and their impact on biodiversity
	Predation/ competition by pest/domestic fauna	• Competition and land degradation by rabbits • Competition and land degradation by unmanaged goats • Predation by feral cats • Predation by the European red fox • Predation, habitat degradation, competition, and disease transmission by feral pigs (*Sus scrofa*) • Novel biota and their impact on biodiversity
	Altered fire regimes	• Fire regimes that cause declines in biodiversity
	Disturbance from increased public access to natural areas	-
	Fauna mortality, displacement, and barriers to movement	-
	Fauna disturbance due to noise, dust, or light	-
	Inadvertent impacts on adjacent habitat or vegetation	-
Cumulative impacts	-	-

Table 17-3: Threat Abatement Plans associated with potentially relevant Key Threatening Processes

Key threatening process	Related Threat Abatement Plan
Competition and land degradation by rabbits	Threat abatement plan for competition and land degradation by rabbits (DoEE, 2016a)
Competition and land degradation by unmanaged goats	Threat abatement plan for competition and land degradation by unmanaged goats (DEWHA, 2008d)
Fire regimes that cause declines in biodiversity	There is no relevant TAP
Infection of amphibians with chytrid fungus resulting in chytridiomycosis	Threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis (DoEE, 2016b)
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP

Key threatening process	Related Threat Abatement Plan
Predation by feral cats	Threat abatement plan for predation by feral cats (DoE, 2015c)
Predation by European red fox	Threat abatement plan for predation by the European red fox (DEWHA, 2008e)
Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs	Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (DoEE, 2017)

17.3.3 THREAT ABATEMENT PLAN FOR COMPETITION AND LAND DEGRADATION BY RABBITS

The goal of this TAP is to minimise the impact of competition and land degradation by rabbits (*Oryctolagus cuniculus*) on biodiversity. Rabbits are abundant in Australia and cause damage to native flora and fauna, vegetation communities and crops. Rabbits can affect threatened species and TECs by:

- Grazing on threatened native vegetation and therefore preventing regeneration
- Competing with threatened fauna species for food and shelter
- Reversing the normal processes of plant succession
- Altering ecological communities and changing soil structure and nutrient cycling, leading to significant erosion
- Removal of critical habitat for arboreal mammals and birds, leading to increased predation
- Supporting elevated population densities of pest predators such as foxes and feral cats
- Promoting growth of introduced and unpalatable species such as weeds (DoEE, 2016a)

OBJECTIVES AND ACTIONS UNDER THE TAP

The TAP sets out four objectives to achieve the goal, they are:

- Strategically manage rabbits at the landscape scale and suppress rabbit populations to densities below threshold levels in identified priority areas
- Improve knowledge and understanding of the impact of rabbits and their interactions with other species and ecological processes
- Improve the effectiveness of rabbit control programs
- Increase engagement of the community of the environmental impacts of rabbits and the need for integrated control

A set of actions have been identified to achieve the objectives of the TAP. There are five actions to support the strategic management of rabbits at a landscape scale. These relate to identifying priority areas for rabbit control on a regional scale, coordinating efforts across all land tenures such as private land and urban areas, and developing regular monitoring and reporting mechanisms to track progress.

There are three actions to improve knowledge and understanding of the impact of rabbits. These relate to further investigating the interaction of rabbits with other species and threats to improve rabbit control measures.

There are eight actions to improve the effectiveness of rabbit control programs through further research.

There are four actions to increase communication with stakeholders around the impacts caused by rabbits. These relate to developing training programs for land managers, promoting and seeking engagement from all people in the community and promoting adoption of model codes of practice for rabbit control (DoEE, 2016a).

RELEVANCE OF THE TAP TO THE PLAN

There is no likelihood of national rabbit eradication, so rabbit control is an ongoing issue across Australia. Current rabbit control programs focus on long-term management and suppression of rabbit populations.

Rabbits are an existing threat within the Geelong locality, with evidence that the NWGGA is currently occupied by the species (EHP, 2021).

Development under the Plan is unlikely to exacerbate the threat posed by rabbits.

CONSISTENCY WITH THE TAP

The Plan is not inconsistent with the TAP on the basis that the Plan will not prevent any of the actions of the TAP from being implemented.

HOW REGARD HAS BEEN GIVEN FOR INFORMATION WITHIN THE TAP

The Strategic Assessment Report has had regard for the TAP through reviewing and considering information within the TAP and ensuring that:

- The Plan is not inconsistent with the TAP
- The Plan will not exacerbate threats associated with this TAP

17.3.4 THREAT ABATEMENT PLAN FOR COMPETITION AND LAND DEGRADATION BY UNMANAGED GOATS

The goal of this is TAP is to minimise the impact of competition and land degradation by unmanaged goats (*Capra hircus*) on biodiversity. Unmanaged goats are free-living and not owned, identified, restrained or managed. Unmanaged goats can affect threatened species and TECs by:

- Grazing on threatened native vegetation and therefore preventing regeneration
- Overgrazing and causing soil erosion
- Competing with threatened fauna species for food and shelter
- Introducing weeds through seeds carried in their dung
- Polluting watercourses (DEWHA, 2008d)

OBJECTIVES AND ACTIONS UNDER THE TAP

The TAP sets out five objectives to achieve the goal, they are:

- Prevent unmanaged goats occupying new areas and eradicate them from high conservation-value 'islands'
- Promote the maintenance and recovery of native species and ecological communities that are affected by competition and land degradation by unmanaged goats
- Improve knowledge and understanding of unmanaged goat impacts and interactions with other species and ecological processes
- Improve the effectiveness, target specificity and humaneness of control options for unmanaged goats
- Increase awareness of all stakeholders of the objectives and actions of the TAP, and of the need to control unmanaged goats (DEWHA, 2008d)

A set of actions accompanies each objective to help achieve the goal of the TAP. There are four actions to prevent unmanaged goats occupying new areas. These relate to collating data on areas of high conservation value and developing and implementing management plans for these areas.

There are three actions to promote the maintenance and recovery of native species and ecological communities that are affected by this threat. These relate to identifying priority areas to control unmanaged goats and conducting and monitoring goat control.

There are four actions to improve knowledge and understanding of unmanaged goat impacts and interactions. These relate to developing methods for assessing and monitoring the impact of unmanaged goats and improving knowledge of interactions between unmanaged goats and other key species.

There are seven actions to improve the control options for unmanaged goats. These relate to investigating ways to improve control methods and programs including:

- Improving self-mustering trap systems
- Assessing goat toxins for undesirable side effects
- Testing exclusion fence designs
- Developing training programs to help land managers
- Promoting the adoption and adaptation of the model codes of practice

There are two actions to increase awareness of stakeholders of the objectives and actions of the TAP which relate to the promotion of the objectives and actions in the TAP.

RELEVANCE OF THE TAP TO THE PLAN

There is little information to suggest that unmanaged goats are currently a problem in the Strategic Assessment Area. However, it is possible that goats are present as they present a widespread threat within Australia.

There are no activities under the Plan which are likely to lead to the introduction of unmanaged goats in the area, or which would otherwise exacerbate the threat of unmanaged goats.

CONSISTENCY WITH THE TAP

The Plan is not inconsistent with the TAP on the basis that the Plan will not prevent any of the actions of the TAP from being implemented.

HOW REGARD HAS BEEN GIVEN FOR INFORMATION WITHIN THE TAP

The Strategic Assessment Report has had regard for the TAP through reviewing and considering information within the TAP and ensuring that:

- The Plan is not inconsistent with the TAP
- The Plan will not exacerbate threats associated with this TAP

17.3.5 THREAT ABATEMENT PLAN FOR INFECTION OF AMPHIBIANS WITH CHYTRID FUNGUS RESULTING IN CHYTRIDIOMYCOSIS

The goal of this TAP is to minimise the impacts of amphibian chytrid fungus (*Batrachochytrium dendrobatidis*) on affected native species and ecological communities.

Chytrid fungus causes chytridiomycosis in amphibians which is a highly infectious disease that can be found in all areas in Australia except the Northern Territory. The fungus invades the surface layers of the skin and disrupts its normal function which results in electrolyte depletion and osmotic imbalance. This can affect the nervous system of some animals and paralysis, and ultimately death, occurs. Susceptibility to the disease varies between populations but the reasons for this are unknown (DoEE, 2016b).

OBJECTIVES AND ACTIONS UNDER THE TAP

The TAP sets out four objectives to help achieve the goal, they are:

- Improve understanding of the extent and impact of infection by amphibian chytrid fungus and reduce its spread to uninfected areas and populations
- Identify and prioritise key threatened amphibian species, populations and geographical areas and improve their level of protection by implementing coordinated, cost-effective on-ground management strategies
- Facilitate collaborative applied research that can be used to inform and support improved management of amphibian chytrid fungus
- Build scientific capacity and promote communication among stakeholders

A set of actions have been identified to achieve the objectives of the TAP. There are four actions to improve the understanding of infection by chytrid fungus and reduce its spread which relate to monitoring at-risk species, mapping the distribution of chytridiomycosis (and chytrid fungus), including control measures in amphibian translocation strategies, and ensuring appropriate hygiene protocols are implemented in chytrid-free areas.

There are six actions to support the identification and prioritisation of key threatened species, populations and geographical areas and the implementation of management strategies, which relate to completing risk assessments for high-priority species, implementing biosecurity measures around high-priority areas, and coordinating conservation efforts.

There are seven actions to facilitate research to improve management of chytrid fungus which include obtaining knowledge on:

- Assisted colonisation strategies
- The mechanisms for resistance
- The severity of chytrid fungus
- The best treatment protocols

There are three actions to build scientific capacity and promote communication among stakeholders which relate to developing an effective communication strategy, supporting a central information storage site, and encouraging participation in the National Chytrid Working Group.

RELEVANCE OF THE TAP TO THE PLAN

There is a known population of Growling Grass Frog which occurs within Cowies Creek in and adjacent to WGGA. This population occurs in an area currently developed for agriculture, upstream from nearby urban development. It is noted that Cowies Creek has variable levels of salinity, with some areas considered saline (EHP, 2021). It is possible that the salinity of Cowies Creek offers this population of the Growling Grass Frog some protection from chytrid fungus.

Overall, chytrid fungus is an existing landscape threat. Implementation of the Plan is not likely to exacerbate this threat. However, ongoing monitoring of the Growling Grass Frog population will be important to understand and mitigate any potential negative affects due to hydrological changes.

CONSISTENCY WITH THE TAP

The Plan is not inconsistent with the TAP on the basis that the Plan will not prevent any of the actions of the TAP from being implemented.

HOW REGARD HAS BEEN GIVEN FOR INFORMATION WITHIN THE TAP

The Strategic Assessment Report has had regard for the TAP through reviewing and considering information within the TAP and ensuring that:

- The Plan is not inconsistent with the TAP
- The Plan will not exacerbate threats associated with this TAP

17.3.6 THREAT ABATEMENT PLAN FOR PREDATION BY FERAL CATS

The goal of this TAP is to minimise predation of native species by feral cats (*Felis catus*).

Feral cats are found throughout all habitats in mainland Australia and Tasmania and on some offshore islands. They are known to have a devastating effect on native fauna, predominantly from predation but also through competition and disease transmission (DoE, 2015c).

OBJECTIVES AND ACTIONS UNDER THE TAP

The TAP sets out four objectives to achieve the goal, they are:

- Effectively control feral cats in different landscapes
- Improve effectiveness of existing control options for feral cats
- Develop or maintain alternative strategies for threatened species recovery
- Increase public support for feral cat management and promote responsible cat ownership

A set of actions have been identified to help achieve the objectives of the TAP. There are nine actions to improve the control of feral cats in different landscapes which relate to further research and development of current and new feral cat control options, improving understanding of the interactions between feral cats and other predators, and development of Code of Practice and/or Standard Operating Procedures for new tools.

There are four actions to improve the effectiveness of existing feral cat control options which relate to understanding how best to encourage land managers to include cat management programs within their activities, providing information regarding best practice methods and standard operating procedures, and implementing a consistent regulatory approach across all state and territory governments.

There are five actions to support the investigation of alternative strategies for threatened species recovery which include eradicating or controlling cats in priority areas, implementing, or improving biosecurity measures in cat-free areas, and creating fenced reserves to support the recovery of threatened species.

There are four actions to increase public support for cat management which relate to increasing awareness and understanding about:

- The threat to biodiversity posed by cats
- The need for responsible cat ownership
- The containment of cats where their roaming may impact priority areas

RELEVANCE OF THE TAP TO THE PLAN

Total eradication of feral cats is not currently feasible and cat control is an ongoing issue across Australia. Current control programs focus on long-term management and suppression of feral cat populations.

Existing land use within the Growth Areas and surrounding region includes residential areas and farming, which means cats are unlikely to pose a novel threat to native fauna in the area. However, proposed new urban development under the Plan means the threat is likely to be exacerbated. The main areas of concern relate to new urban development in proximity to the Northern Conservation Area, the Eastern Conservation Area, the Gully Avoidance Area in the NGGA, and in proximity to Cowies Creek in the WGGA.

The existing standard mitigation measures are considered adequate in addressing the potential indirect impacts of development on protected matters in relation to predation or competition by pest or domestic fauna.

CONSISTENCY WITH THE TAP

The Plan is not inconsistent with the TAP on the basis that the Plan will not prevent any of the actions of the TAP from being implemented.

HOW REGARD HAS BEEN GIVEN FOR INFORMATION WITHIN THE TAP

The Strategic Assessment Report has had regard for the TAP through reviewing and considering information within the TAP and ensuring that:

- The Plan is not inconsistent with the TAP
- The Plan will not exacerbate threats associated with this TAP

17.3.7 THREAT ABATEMENT PLAN FOR PREDATION BY EUROPEAN RED FOX

The goal of this TAP is to minimise the impact of the European red fox (*Vulpes Vulpes*) on biodiversity in Australia (DEWHA, 2008e).

The European red fox can be found all over the Australian mainland, apart from in the far North. Fox predation is a threat to many threatened fauna species, in particular terrestrial mammals and ground-nesting birds.

OBJECTIVES AND ACTIONS UNDER THE TAP

The TAP sets out four objectives to achieve the goal, they are:

- Prevent foxes occupying new areas in Australia and eradicate foxes from high-conservation-value 'islands'
- Promote the maintenance and recovery of native species and ecological communities that are affected by fox predation
- Improve knowledge and understanding of fox impacts and interactions with other species and other ecological processes
- Improve the effectiveness, target specificity, integration, and humaneness of control options for foxes
- Increase awareness of all stakeholders of the objectives and actions of the TAP, and of the need to control and manage foxes

A set of actions have been identified to help achieve the objectives of the TAP. There are four actions to prevent foxes occupying new areas in Australia which relate to collating data on areas with high conservation values, developing and implementing management plans, and eradicating populations of foxes from lands adjacent to priority areas.

There are three actions to promote the recovery of native species and ecological communities that are affected by fox predation which relate to identifying priority areas for fox control and undertaking and monitoring fox control at these locations.

There are five actions to improve the knowledge and understanding of fox impacts which relate to developing methods for monitoring foxes, exploring the interactions between foxes, feral cats, wild dogs, and rabbits, and estimating the costs of impacts from foxes.

There are seven actions to improve the control options for foxes which relate to investigating existing and new control techniques, developing training programs for land managers, and promoting best practice standards.

There is one action to increase awareness of the need to control and manage foxes which relates to ensuring that the actions in the TAP are better communicated.

RELEVANCE OF THE TAP TO THE PLAN

Foxes are an existing threat within the Geelong locality, with evidence that the NWGGA is currently occupied by the species (EHP, 2021).

Development under the Plan is unlikely to exacerbate the threat posed by foxes.

CONSISTENCY WITH THE TAP

The Plan is not inconsistent with the TAP on the basis that the Plan will not prevent any of the actions of the TAP from being implemented.

HOW REGARD HAS BEEN GIVEN FOR INFORMATION WITHIN THE TAP

The Strategic Assessment Report has had regard for the TAP through reviewing and considering information within the TAP and ensuring that:

- The Plan is not inconsistent with the TAP
- The Plan will not exacerbate threats associated with this TAP

17.3.8 THREAT ABATEMENT PLAN FOR PREDATION, HABITAT DEGRADATION, COMPETITION AND DISEASE TRANSMISSION BY FERAL PIGS (*SUS SCROFA*)

The goal of this TAP is to prevent further species and ecological communities from becoming threatened or extinct due to the impacts of feral pigs.

Feral pigs are widespread throughout Australia and can affect threatened species and ecological communities by:

- Consuming threatened fauna species
- Destroying threatened flora species
- Altering ecological parameters such as plant species composition and succession, nutrient and water cycles, and water quality
- Changing the composition of threatened plant communities
- Altering soil structure
- Increasing the spread of weeds
- Spreading animal diseases such as leptospirosis, brucellosis, and plant pathogens such as *Phytophthora cinnamomic* (DoEE, 2017)

OBJECTIVES AND ACTIONS UNDER THE TAP

The TAP sets out six objectives to achieve the goal, they are:

- Prioritise key species, ecological communities, ecosystems, and locations across Australia for strategic feral pig management
- Encourage the integration of feral pig management into land management activities at regional, state and territory, and national levels
- Encourage further scientific research into feral pig impacts on nationally threatened species and ecological communities, and feral pig ecology and control
- Record and monitor feral pig control programs, so their effectiveness can be evaluated
- Build capacity for feral pig management and raise feral pig awareness amongst landholders and land managers
- Improve public awareness about feral pigs and the environmental damage and problems they cause, and the need for the feral pig control

A set of actions have been identified to help achieve the objectives of the TAP. There are two actions to support strategic feral pig management which include identifying priority species, ecological communities, ecosystems, and locations for priority protection, and implementing control measures in these areas.

There is one action to support the integration of feral pig management into land management activities which relates to encouraging government departments and agencies, and regional groups, to integrate feral pig management into their land management activities.

There are four actions to encourage further scientific research into feral pig impacts which include undertaking more research into:

- Feral pig impacts
- Feral pig population dynamics and ecology
- Special and temporal use of landscapes by feral pigs
- The effectiveness of feral pig control methods

There are three actions to evaluate the effectiveness of feral pig control programs which relate to developing better monitoring techniques and encouraging centralised recording of feral pig control actions.

There are two actions to raise feral pig awareness amongst landholders and land managers which relate to increased delivery of training programs to build feral pig management skills and improve the understanding of special impediments to feral pig control.

There are two actions to improve public awareness about feral pigs which include developing a public education program about feral pigs and the environmental damage and problems they could cause.

RELEVANCE OF THE TAP TO THE PLAN

Feral pigs are widely established in Australia, and it is not currently possible to completely eradicate them (DoEE, 2017).

There is little information to suggest that feral pigs are currently a problem in the Strategic Assessment Area. However, it is possible that feral pigs are present as they present a widespread threat within Australia.

There are no activities under the Plan which are likely to lead to the introduction of feral pigs in the area, or which would otherwise exacerbate the threat of feral pigs.

CONSISTENCY WITH THE TAP

The Plan is not inconsistent with the TAP on the basis that the Plan will not prevent any of the actions of the TAP from being implemented.

HOW REGARD HAS BEEN GIVEN FOR INFORMATION WITHIN THE TAP

The Strategic Assessment Report has had regard for the TAP through reviewing and considering information within the TAP and ensuring that:

- The Plan is not inconsistent with the TAP
- The Plan will not exacerbate threats associated with this TAP

18 Relevant protected matters

18.1 INTRODUCTION

This Chapter lists the relevant protected matters for the assessment.

The 'relevant protected matters' are defined in the ToR as *"…each protected matter that may be impacted directly, indirectly and/or cumulatively by actions proposed to be taken under the Plan"*.

The methods used to identify these matters according to this definition are described in Chapter 12 of Part 3 of this report. As described in Chapter 12, identification of the relevant protected matters was undertaken using different methods for each of the following groups:

- Commonwealth threatened listed threatened species and species on the FPAL
- Commonwealth listed threatened ecological communities
- Commonwealth listed migratory species
- Wetlands of international importance (listed under the Ramsar Convention)
- Commonwealth land
- World heritage properties and national heritage properties

Matters that were considered relevant were assigned to 'Category 1' and assessed in detail in Part 4 of this report. Category 1 matters were those that were considered at risk of direct, indirect, or cumulative impacts due to implementation of the Plan.

Matters that were identified and examined but determined not to be relevant based on the definition of 'relevant protected matters' provided by the ToR were assigned to 'Category 2'. These matters are not at risk of direct, indirect, or cumulative impacts due to implementation of the Plan or are not reliant on or present within the Strategic Assessment Area. For these matters, no further assessment is required.

The detailed analysis and results of the categorisation process are presented in Attachment A.

18.2 CATEGORISATION RESULTS

18.2.1 THREATENED SPECIES AND ECOLOGICAL COMMUNITIES AND FPAL SPECIES

A total of 26 threatened and FPAL species have been identified as Category 1 species requiring detailed assessment. These include:

- Flora:
  - *Lachnagrostis adamsonii* (Adamson's Blown-grass)
  - *Pimelea spinescens* subsp. *spinescens (*Spiny Rice-flower)
- Fauna:
  - *Botaurus poiciloptilus* (Australasian Bittern)
  - *Calidris acuminata* (Sharp-tailed Sandpiper)
  - *Calidris canutus* (Red Knot)
  - *Calidris ferruginea* (Curlew Sandpiper)
  - *Calidris tenuirostris* (Great Knot)
  - *Charadrius leschenaultii* (Greater Sand Plover)
  - *Charadrius mongolus* (Lesser Sand Plover)
  - *Delma impar* (Striped Legless Lizard)
  - *Gallinago hardwickii* (Latham's Snipe)
  - *Galaxiella toourtkoourt* (Little Galaxias)*
  - *Limosa lapponica baueri* (Western Alaskan Bar-tailed Godwit)

- *Limosa limosa* (Black-tailed Godwit)
- *Litoria raniformis* (Growling Grass Frog)
- *Nannoperca obscura* (Yarra Pygmy Perch)
- *Neophema chrysogaster* (Orange-bellied Parrot)
- *Neophema chrysostoma* (Blue-winged Parrot)
- *Numenius madagascariensis* (Eastern Curlew)
- *Prototroctes maraena* (Australian Grayling)
- *Rostratula australis* (Australian Painted Snipe)
- *Sternula albifrons* (Little Tern)
- *Sternula nereis nereis* (Australian Fairy Tern)
- *Synemon plana* (Golden Sun Moth)
- *Tringa nebularia* (Common Greenshank)
- *Tympanocryptis pinguicolla* (Victorian Grassland Earless Dragon)

One TEC has been identified as a Category 1 TEC requiring detailed assessment. This TEC is Natural Temperate Grassland of the Victorian Volcanic Plain.

Refer to Attachment A for a detailed overview of results.

* One FPAL species has been identified as a Category 1 species requiring detailed assessment. This species is *Galaxiella toourtkoourt* (Little Galaxias). The species was previously known as *Galaxiella pusilla,* though has been formally re-described as two species, *Galaxiella toourtkoourt* and *Galaxiella pusilla* (Coleman, Hoffman and Raaik, 2015). Prior to taxonomic revision, both species were listed as Vulnerable as *Galaxiella pusilla*. Due to the recent taxonomic revision, and pending listing of *G. toourtkoourt,* it is appropriate to assess this species as a threatened species.

18.2.2 MIGRATORY SPECIES

A total of three non-threatened migratory species have been identified as Category 1 species requiring detailed assessment. All non-threatened migratory species requiring assessment are migratory birds. They include:

- *Calidris ruficollis* (Red-necked Stint)
- *Charadrius bicinctus* (Double-banded Plover)
- *Tringa stagnatilis* (Marsh Sandpiper)

Note that there are also twelve threatened migratory species which have been assigned to Category 1 as part of the threatened species categorisation process. These species are assessed within the threatened fauna chapter (Chapter 19). They include:

- *Calidris acuminata* (Sharp-tailed Sandpiper)
- *Calidris canutus* (Red Knot)
- *Calidris ferruginea* (Curlew Sandpiper)
- *Calidris tenuirostris* (Great Knot)
- *Charadrius leschenaultii* (Greater Sand Plover)
- *Charadrius mongolus* (Lesser Sand Plover)
- *Gallinago hardwickii* (Latham's Snipe)
- *Sternula albifrons* (Little Tern)
- *Limosa lapponica baueri* (Western-Alaskan Bar-tailed Godwit)
- *Limosa limosa* (Black-tailed Godwit)
- *Numenius madagascariensis* (Eastern Curlew)
- *Tringa nebularia* (Common Greenshank)

Refer to Attachment A for a detailed overview of results.

18.2.3 RAMSAR WETLANDS

One Ramsar site, the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula, was identified within the Study Area. Areas of this Ramsar site are located downstream of the Growth Areas and have the potential to be indirectly impacted by development under the Plan. The site has been assigned to Category 1 for detailed assessment.

18.2.4 COMMONWEALTH LAND

Four Commonwealth land sites were identified through the PMST report. They are:

- AIRTC Geelong. This site occurs more than 3 km to the south of the Strategic Assessment Area in a built up area of Geelong
- Avalon Airfield. This site occurs more than 6 km to the east of the Strategic Assessment Area
- Myers Street (opp. Geelong Hospital). This site occurs approximately 4 km to the south of the Strategic Assessment Area in a built up area of Geelong
- Point Wilson Explosives Area. This site occurs more than 13 km to the east of the Strategic Assessment Area

The existing landscape context of the sites and the distance to the Growth Areas means that impacts to Commonwealth land will not occur as a result of implementation of the Plan. All sites were assigned to Category 2.

18.2.5 WORLD HERITAGE PROPERTIES, NATIONAL HERITAGE PROPERTIES

No world heritage properties or national heritage places were identified through this search. No further assessment was undertaken of these matters.

19 Listed threatened fauna

This chapter assesses the potential impacts of the Plan on fauna species listed as threatened under the EPBC Act.

The categorisation process for the assessment identified 18 threatened fauna species which may potentially be impacted by implementation of the Plan. Sections 19.1 to 19.6 assess the potential impacts of the Plan on these species.

Refer to Section 12.3 of Chapter 12 for the method used to identify relevant protected matters.

KNOWN TO OCCUR WITHIN THE GROWTH AREAS

Three threatened fauna species are known to occur within the Growth Areas and are assessed in this section. They are:

- Golden Sun Moth
- Growling Grass Frog
- Striped Legless Lizard

19.1 GOLDEN SUN MOTH (*SYNEMON PLANA*)

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, populations and threats. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable
DESCRIPTION	Golden Sun Moth (GSM) (*Synemon plana*) is a medium-sized day-flying moth. The sexes are distinguished by wing colour. Males are dark brown with pale grey patterning and a hind wing that is dark bronze-brown with dark brown patches. Females are dark grey with pale grey patterning and a hind wing that is bright orange with black submarginal spots (DAWE, 2021a).
ECOLOGY	The life cycle of GSM comprises an underground stage (egg, larva and pupa) that can last up to 2 or 3 years, and an adult stage that lasts only a few days. Females lay their eggs at the base of grass tussocks. Once hatched, the larvae develop underground where they feed on the roots of the tussocks. Pupation occurs in Spring and the adults emerge during the breeding season, which is between mid-October to early January. Adults have no functional mouth parts and do not feed. They are most active during sunny, still, warm to hot days when males can be found patrolling habitat for females by flying about 1 m above the ground in rapid, short bursts during late morning and early afternoon. Males are capable of active and prolonged flight, though are unlikely to travel long distances (greater than 100 m) away from suitable habitat. Females are typically active later in the afternoon and are semi-flightless, flashing their bright wings in sedentary positions. After mating, females lay their eggs and then the adult moths die (DAWE, 2021a).
DISTRIBUTION AND HABITAT	GSM is found in grassland habitat in south-eastern Australia. Its distribution ranges from central NSW between Parkes and Bathurst, through the ACT, down to central and western Victoria and just across the border to eastern South Australia. The Extent of Occurrence and Area of Occupation are currently understood to be 145,322 km² and 1,596 km² respectively (DAWE, 2021a). Within Victoria, 11 Local Government Areas are recognised as important for the species (SWIFFT, 2022). The species is known to occur within the City of Greater Geelong, however it is not listed as an important LGA. Habitat for GSM comprises generally flat or gently sloping areas exposed to full sun that contain (or have once contained) native grassland, open grassy woodlands and secondary grasslands that retain a component of larval food species. Previously, GSM was only thought to occur in

	grasslands dominated by species from the genus *Rytidosperma*, or Wallaby Grass. However, GSM is also known to occur in degraded areas that retain some native larval food species, or have been invaded by the introduced Needlegrass species such as Chilean Needle-grass *Nassella neesiana*, which is also a known food plant (DAWE, 2021a). Despite this, it is important to note that the natural habitat of GSM is native grasslands which include Wallaby-grass *Rytidosperma* and Spear-grass *Austrostipa* species ((SWIFFT, 2022). The species Conservation Advice refers to important (or high quality) habitat areas as those comprising (DAWE, 2021a): *"…medium to large sites containing native grassland with an abundant component of larval food species (i.e., Rytidosperma spp. and/or Austrostipa spp.) with low weed cover, inter-tussock spaces, and land-use/management that is consistent with the ecological values of the site."* According to the Conservation Advice, large subpopulations, or smaller, well-connected subpopulations that occur within high quality habitat are likely to be important in the long-term maintenance of the species, including maintenance of genetic diversity and long-term evolutionary development. The definition of habitat critical to the survival of the species is yet to be resolved, but is currently defined broadly as (DAWE, 2021a): *"…all native grassland and open grassy woodland habitat occupied by the species across its range…* [as well as] *…sites occurring at or toward the limit of the species range, or sites that are a long distance from other known subpopulations".*
POPULATIONS	According to the Conservation Advice, GSM is known from 164 sites (DAWE, 2021a). Of these, 104 sites occur in Victoria. Sites separated by distances of greater than 200 m are likely to be geographically isolated. Genetic differentiation among subpopulations is correlated with geographic distance. The Victorian subpopulations are evolutionarily distinct from the NSW/ACT subpopulations, and represent evolutionarily significant units (DAWE, 2021a).

THREATS	The Conservation Advice (DAWE, 2021a) for the species has identified a number of threats, including:
	• Habitat loss, degradation, and fragmentation, including:
	  ○ Land clearing for urban development and agriculture
	  ○ Soil disturbance, due to laying of infrastructure, driving of vehicles and other machinery on wet soil, activities such as ploughing, cultivation and ripping, and due to rabbit burrows
	  ○ Inappropriate removal of biomass from grasslands, including lack of biomass removal, or intense grazing and/or mowing
	  ○ Application of chemicals such as herbicides, pesticides, or fertilisers
	  ○ Planting and / or regeneration of shrubs / trees
	• Invasive species, including:
	  ○ Weed invasion
	  ○ Habitat degradation by rabbits
	• Installation of artificial structures which increases predation by native and introduced birds
	• Inappropriate fire regimes

RELEVANT PLANS AND POLICIES	Conservation Advice for *Synemon plana* (Golden Sun Moth) (DAWE, 2021a) Threat abatement plan for competition and land degradation by rabbits (DoEE, 2016a)
SPECIES-SPECIFIC GUIDELINES	There are no current Significant Impact Guidelines or other species-specific policy statements for the GSM. However, significant impact guidelines have been prepared for the species when it was listed as Critically Endangered - Significant impact guidelines for the critically endangered golden sun moth (Synemon plana): Nationally threatened species and ecological communities EPBC Act policy statement 3.12 (DEWHA, 2009d)
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=25234

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *An overview of the habitat mapping for the species within and outside the Growth Areas*
- *An overview of the population mapping for the species*

Please refer to Chapter 13 for further details about the approach to threatened species baseline data, including a description of the different types and sources of data, as well as some discussion on the interpretation and suitability of the data for use in the impact assessment.

HABITAT MAPPING	**WITHIN THE SURVEYED AREAS OF THE GROWTH AREAS**
	Habitat mapping for the impact assessment within the surveyed areas of the Growth Areas used the following data sources:
	• EHP survey results (EHP, 2021)
	• Landholder survey results (Nature Advisory, 2021)
	The following categories of habitat were created using this data:
	• Higher potential native habitat, comprising areas that contain both:
	  ○ EHP-mapped GSM habitat
	  ○ Areas mapped as native vegetation as part of landholder surveys
	• Moderate potential native habitat, comprising areas that contain both:
	  ○ EHP-mapped GSM habitat
	  ○ EHP-mapped native vegetation within areas not subject to landholder surveys
	• Lower potential native habitat, comprising areas that contain both
	  ○ EHP-mapped GSM habitat
	  ○ Areas identified as non-native vegetation as part of landholder surveys
	• Non-native habitat, comprising areas that contain both:
	  ○ EHP-mapped GSM habitat
	  ○ Areas of non-native vegetation according to both EHP surveys and landholder surveys

	WITHIN THE UNSURVEYED AREAS OF THE GROWTH AREAS A combination of DELWP's GSM HIM (DELWP, 2017d) and DELWP's EVC mapping for EVC 132 (Plains Grassland) (DELWP, 2005) was used to provide an indication of potential habitat extent within the unsurveyed areas of the Growth Areas
	OUTSIDE THE GROWTH AREAS Habitat mapping across the broader Strategic Assessment Area and Study Area was based on the GSM HIM prepared by DELWP (DELWP, 2017d)
POPULATION MAPPING	**RECORD SELECTION** Species records were compiled from the VBA and surveys undertaken by EHP. The VBA records were filtered to remove records prior to 1990 for the purpose of the impact assessment
	RECORD DOWNLOAD DATE VBA records for GSM used in this assessment were downloaded in February 2025
	POPULATION DEFINITION The population of GSM identified within the NWGGA is considered one population given the connectivity of habitat and continuity of survey records

OCCURRENCE IN THE STUDY AREA

This section describes the occurrence of the species in the Study Area. It includes reference to maps of records and habitat which can be viewed as separate files. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

See Map 19-1 for a map of records and habitat across the Study Area. See Map 19-2 for a map for records and habitat within the Strategic Assessment Area, and Map 19-3 for a map of habitat within the Strategic Assessment Area.

19.1.1 SPECIES RECORDS

Occurrence within the Growth Areas

Targeted surveys were undertaken for GSM within the Growth Areas between November 2019 and December 2020 (EHP, 2021). A population of GSM comprised of over 2,000 individuals was confirmed to occur within the NGGA (see Map 19-2). These records are considered to represent a single population based on the continuity of records and associated habitat across the NGGA.

GSM was not recorded within the WGGA (EHP, 2021).

Occurrence within the Strategic Assessment Area and broader Study Area

There are two VBA records of GSM within the Strategic Assessment Area. These records occur between the north-east Strategic Assessment Area boundary and NGGA boundary.

There are 856 VBA records of GSM across the broader Study Area. The most recent of these was recorded in 2020. Records across the Study Area occur mostly in four areas, including near Avalon, north of Little River, near Lethbridge, and in an area approximately 2 km north of the Strategic Assessment Area.

Given the level of homogeneity across the landscape in terms of current land use and historical native grassland extent, the species is likely to be more widespread in the Study Area than indicated by records. The current number and distribution of historical records is more likely to reflect the level of targeted survey effort rather than the actual occurrence of the species for the following reasons:

- The distribution of records does not reflect a clear pattern of habitat availability for the species in this region
- The species is less likely to be opportunistically sighted given the restricted window of emergence and detectability
- Records are generally clustered according to date in discrete locations across the landscape, which is likely to represent particular survey events

On this basis, the abundance and density of records within the NGGA is considered to be reflective of survey effort, rather than the importance of the site for the species relative to the broader landscape.

19.1.2 POTENTIAL HABITAT

Habitat within the surveyed areas of the Growth Areas

Targeted surveys within the Growth Areas have informed baseline habitat mapping for GSM. Potential habitat for the species occurs within the NGGA, while the WGGA is unlikely to support the species.

The species Conservation Advice notes that all occupied habitat is considered important to the recovery of the species. However, it places the greatest emphasis on the importance of native habitat compared to non-native habitat and identifies high quality habitat as *"medium to large sites containing native grassland with an abundant component of larval food species (i.e., Rytidosperma spp. and/or Austrostipa spp.) with low weed cover, inter-tussock spaces, and land-use/management that is consistent with the ecological values of the site"* (DAWE, 2021a).

The EHP surveys found the Growth Areas to be dominated by non-indigenous grasses and weeds (i.e., pasture grasses), which reflects the region's long history of agricultural use. Much of the indigenous vegetation and terrestrial fauna habitat remaining within the Growth Areas was found confined to riparian corridors in the WGGA (i.e., Moorabool River, Cowies Creek), or agricultural areas not subjected to historical cropping. Native vegetation, where present, was highly modified, generally lacking structure and exhibiting a low diversity of native species.

Subsequent site visits as part of the Strategic Assessment process, as well as the results of landholder surveys, have confirmed these findings and shown an increased prevalence of weeds since the time of the EHP surveys in 2019 and 2020. Advice from a grassland restoration expert suggests this points to a decline in the condition of native vegetation.

Much of habitat within the NGGA is unlikely to represent an important or high quality area necessary for the long-term maintenance of the species (as described in the Conservation Advice (DAWE, 2021a)), due to the level of weeds, land modification, and rate of decline. To distinguish between native vs non-native habitat for the assessment of impacts to GSM and to reflect this declining trend in condition, habitat within the surveyed areas of the Growth Areas has been mapped according to the following categories:

- Higher potential native habitat, which identifies the habitat areas with the greatest likelihood of supporting native vegetation based on the result of EHP surveys and the more recent landholder surveys
- Moderate potential native habitat, which identifies the habitat areas that have the potential to still support native vegetation identified through the EHP surveys, but recognising the declining trend in condition observed elsewhere in the Growth Areas and lack of more recent surveys for these areas
- Lower potential native habitat, which identifies the habitat areas which have likely declined since the time of EHP surveys and are no longer expected to support native vegetation, based on the results of more recent landholder surveys
- Non-native habitat, which identifies areas of GSM habitat which do not support native vegetation

Table 19-1 provides the area of each habitat category mapped within the surveyed areas of the NGGA.

Table 19-1: Golden Sun Moth habitat occurring within surveyed areas of the NGGA

Habitat category	Area of habitat within the surveyed areas of the NGGA (ha)	Percentage of total habitat within the surveyed areas of the NGGA
Higher potential native habitat	21.1	3.1 %
Moderate potential native habitat	65.5	9.7 %
Lower potential native habitat	44.4	6.6 %
Non-native habitat	545.3	80.6 %
Total	**676.3**	-

HABITAT WITHIN THE UNSURVEYED AREAS OF THE GROWTH AREAS

There is potential for GSM to occur within the unsurveyed areas of the Growth Areas. However, these areas generally comprise many small, rural residential landholdings which are fragmented by windrows/landscaping and have a much higher proportion of land use for dwellings and driveways compared to the broader Growth Areas. The environment within these unsurveyed areas tends to be more modified or degraded as a result.

This rural residential land use minimises the likelihood that the properties support significant areas of suitable, high quality or native habitat for the GSM or an abundance of the species. However, in the absence of targeted surveys and recognising the potential for some areas of GSM habitat to occur, an estimate of potential habitat has been determined for the unsurveyed areas using the following method:

- It has been assumed that the entirety of the two unsurveyed blocks of land along the western boundary of the NGGA support potential GSM habitat based on their location adjacent to mapped surveyed habitat and the apparent continuity of land use. Altogether, these two blocks are assumed to contain around 42 ha of potential habitat. It is relevant to note that the property along the western boundary towards the north of the NGGA (870 Geelong-Ballan Road) was able to be accessed as part of more recent surveys for the Grassland Earless Dragon. These recent surveys did not target GSM, but did confirm the presence of potentially suitable native grasses across some parts of the site, supporting this assumption of potential habitat
- The remaining areas of unsurveyed land comprise the rural residential blocks, which are expected to support a reduced or more fragmented distribution of potential habitat which reflects the different land use compared with the surveyed areas of the NGGA. Potential GSM has been modelled across these areas using a combination of DELWP's GSM HIM (DELWP, 2017d) and DELWP's EVC mapping for EVC 132 (Plains Grassland) (DELWP, 2005). This modelling approach identified a further 48 ha of potential habitat

Altogether, this mapping method identified around 90 ha of potential habitat within the unsurveyed areas of the Growth Areas. Of this, 18.2 ha occurs within the portion of Heales Road East subject to process based development.

This method is considered to be suitably precautionary for the purposes of the assessment. This method is intended to identify an area of potential GSM habitat within the unsurveyed land that over-predicts extent, as supported by observations of the properties as part of recent site visits during the strategic assessment.

HABITAT WITHIN THE STRATEGIC ASSESSMENT AREA AND BROADER STUDY AREA

DELWP's HIM for GSM was used to indicate potential habitat within the Strategic Assessment Area and broader Study Area.

Table 19-2 provides the area of GSM habitat mapped within these areas.

Table 19-2: GSM habitat occurring across the broader Study Area

Area	Area of modelled habitat (ha)
Strategic Assessment Area*	23.6
Study Area#	19,628.1
Total modelled habitat	**19,651.7**

* This includes the modelled habitat in the Strategic Assessment Area excluding habitat mapped in the Growth Areas

This includes the modelled habitat in the Study Area excluding the habitat mapped in the Strategic Assessment Area

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of development within the Growth Areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 16.

Avoidance within the NGGA was determined through a structured decision making process as part of the strategic assessment to identify the optimal layout of development and conservation land in the Growth Area (see Section 16.3 of Chapter 16). A key input to evaluate the biodiversity outcomes of the preferred NGGA layout was the avoidance and protection of GSM habitat.

The outcome from this process was the avoidance of a total of 124.1 ha of GSM habitat comprising 113.2 ha of recorded GSM habitat as well as 10.9 ha of potential habitat in the unsurveyed areas. This avoidance focussed on habitat areas in the north of the NGGA where high densities of GSM were recorded and where the largest remnants of native vegetation have been mapped, including around 66 per cent of the areas with high/moderate potential for supporting native habitat. The avoided areas of GSM habitat within the northern parts of the NGGA include:

- 55.1 ha of moderate potential native habitat
- 0.6 ha of lower potential native habitat
- 52.9 ha of non-native habitat
- 10.9 ha of unsurveyed potential habitat within the property at 870 Geelong-Ballan Road. It is noted that this property was accessed as part of recent surveys for the Victorian Grassland Earless Dragon. This survey confirmed the presence of native grasses which are likely to be suitable for GSM

Of the 124.1 ha of the total mapped habitat that will be avoided, most (119.5 ha) will be protected and managed as an offset within the Northern Conservation Area to maintain and enhance the habitat values for GSM (see Section 19.1.6). The Northern Conservation Area provides for connectivity between a known population within the NGGA to areas that could potentially support the species to the north and west.

The remaining mapped habitat to be avoided (4.6 ha) is located within the gully avoidance area. This avoidance area is located in the south of the Elcho Road East precinct, and is a 7.9 ha in size. This avoidance area connects to the Eastern Conservation Area which will be protected and managed as an offset site for Natural Temperate Grassland.

The structured decision making process that led to the avoidance of GSM habitat had to appropriately balance the relevant social, economic and environmental issues. Further avoidance of GSM habitat was not achievable or appropriate for the following key reasons:

- Based on advice from a grassland restoration expert, there were significant concerns that further avoidance of land would not deliver real conservation outcomes due to the extent of weeds and level of degradation across much of the NGGA. There was uncertainty around the efficacy of management and restoration work in additional areas due to the level of modification and extent of weeds. Efforts to address these issues would likely be prohibitively expensive and may be ineffective, noting that some areas were degraded to the point that re-establishment of native grasses may not be feasible within a 10 year timeframe
- From an economic perspective, the cost of acquiring additional land for conservation and management and the associated reduction in net developable area would likely make development across the Growth Area unviable

There is also some potential for GSM to occur within the external infrastructure footprints within the Strategic Assessment Area, outside of the Growth Areas. The Commitments and Measures under the Plan require:

- Targeted surveys within areas that may support GSM along these corridors prior to development and
- Demonstrated avoidance of any confirmed areas of habitat for GSM, to the full extent possible

DIRECT IMPACTS

This section provides an analysis of any direct impacts. Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat.

19.1.3 IMPACTS TO KNOWN POPULATIONS AND POTENTIAL HABITAT

Development under the Plan will reduce the size and extent of the GSM population that has been recorded within the NGGA. There will be direct loss of 642.2 ha of mapped and potential habitat across the southern sections of the NGGA. The majority (76 per cent) of habitat to be cleared comprises non-native habitat. Around 33.5 per cent of surveyed habitat with high/moderate potential for supporting native habitat will be cleared.

Altogether, direct impacts to GSM include:

- The following areas within the surveyed areas of the Growth Areas:
  - 18.5 ha of higher potential native habitat
  - 10.5 ha of moderate potential native habitat
  - 43.8 ha of lower potential native habitat
  - 490.3 ha of non-native habitat
- 79.1 ha of potential habitat within the unsurveyed areas of the Growth Areas. Of this, 18.2 ha occurs within the portion of Heales Road East subject to process based development

This extent of habitat clearing is not expected to lead to the loss of the entire population. A large area of GSM habitat not subject to direct impacts will be retained, protected and managed within the Northern Conservation. This habitat is known to support a component of the GSM population, with a high abundance of individuals recorded during the most recent targeted surveys in 2020. The current extent of mapped habitat retained within the Northern Conservation Area is 119.5 ha. This is notably larger than many sites currently known to support subpopulations across its range, which are confined to small grassland remnants of fewer than 5 ha (DAWE, 2021a). Ongoing management and restoration of this land will remove the key threats currently operating on the population in the NGGA, aiming to halt or reverse declines in habitat condition and improve the longer-term viability of the population.

19.1.4 FRAGMENTATION OF HABITAT

GSM habitat within the NGGA is already bounded by rural residential more intensive land uses to the south and east. The existing interface of habitat in the avoided area with rural lands to the north will be unchanged.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The Plan has the potential to introduce or exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 17 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 17 in order to understand the conclusions reached in this section.

19.1.5 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice for GSM identifies a range of threats to the species (DAWE, 2021a). The following threats to GSM are potentially relevant to implementation of the Plan and are discussed further below:

- Spread of weeds
- Inappropriate fire regimes

The species is most vulnerable to indirect impacts associated with these threats at the following locations:

- Within the Northern Conservation Area that will be established in the NGGA
- In the gully avoidance area
- In areas of potential habitat that might occur adjacent to the Growth Areas or within the immediate vicinity

There are a number of additional threats to the species identified in the Conservation Advice. However, potential indirect impacts to the species associated with these threats are considered unlikely as a result of development under the Plan. Refer to Section 17.2 of Chapter 17 for a detailed assessment of potential indirect impacts associated with implementation of the Plan.

Climate change is also identified as a threat to the species. The potential impacts of climate change and relevant mitigation measures under the Plan are outlined in Section 29.5 of Chapter 29.

SPREAD OF WEEDS

The spread of weeds is a threat to GSM's native habitat. Introduced pasture grasses and clovers readily out-compete native Spear-grasses and Wallaby-grasses which are present in native GSM habitat. The invasion of weeds impacts the species by reducing the availability of larval host plants, and changing the structure of grasslands which may result in the loss of habitat (DAWE, 2021a). Although the species does inhabit non-native grasslands, habitat with a high component of weeds is considered to be of lower quality. Non-native habitat offers reduced larval food plants and is at higher risk of loss from habitat modification (DAWE, 2021a).

Although the invasion of weeds is considered to be a significant threat to GSM (DAWE, 2021a), the Plan is unlikely to exacerbate this threat. Weed invasion is a significant existing issue in the Growth Areas, as reported by EHP, landholder surveys and more recent site observations. Development activities are unlikely to influence the spread of weeds in a way that notably impacts GSM.

It is also noted that standard weed management protocols will be a relevant requirement of development through the existing planning system.

Further, areas of GSM habitat that are retained and protected in the Northern Conservation Area will be subject to management to improve the condition of native grassland. A conservation interface will be established between urban development and the Conservation Area to mitigate potential edge effects, including weeds. This measure will be delivered through Commitment 14, which requires a list of actions to be implemented as part of development to mitigate the indirect impacts of development on the Northern Conservation Area.

Refer to Section 17.2.3 of Chapter 17 for a detailed assessment of potential indirect impacts associated with the spread of weeds under the Plan.

INAPPROPRIATE FIRE REGIMES

There is limited information available regarding the impact of fire on GSM. It is possible that fires may benefit the species through reducing the presence of species (both native, such as Kangaroo Grass, and introduced species) which compete with GSM food plants and through reducing overall grassland biomass and vegetation density at the site (DAWE, 2021a).

It is also possible that fires may negatively impact on the species either through mortality of eggs, pupae and/or adults, and/or through short-term food shortages following fires. It is possible that the species' post-fire persistence at a given location is dependent upon its capacity for recolonisation from other surrounding areas, and that fires may pose a risk of localised extinctions at small sites (DAWE, 2021a).

The Plan is considered unlikely to notably change or contribute to this threat in the Growth Areas or more broadly given the existing level of development in the Greater Geelong region. The planning system has existing standard mitigation measures in place to address the risk of altered fire regimes and increased fire risk from development. This includes a broad requirement to ensure development can implement bushfire protection measures without unacceptable impacts to biodiversity through appropriate planning.

In addition, the conservation interface established between urban development and the Northern Conservation Area, as well as the ongoing management within the Northern Conservation Area itself, will provide for appropriate fire management to protect GSM habitat values.

Refer to Section 17.2.5 of Chapter 17 for a detailed assessment of potential indirect impacts associated with inappropriate fire regimes under the Plan.

OFFSETS TO COMPENSATE FOR RESIDUAL ADVERSE IMPACTS

This section identifies any offsets needed to address residual adverse impacts to listed threatened species.

19.1.6 OFFSETS TO ADDRESS POTENTIAL IMPACTS ASSOCIATED WITH DEVELOPMENT WITHIN THE GROWTH AREAS

There will be residual adverse impacts to GSM as a result of clearing of known and potential habitat within the developable areas of the NGGA. The majority of these impacts are to non-native habitat areas.

To compensate for these impacts, the Plan will deliver an offsets package for GSM comprising two key elements:

- Protection and ongoing management of 108.6 ha of known GSM habitat, and 10.9 ha of potential habitat within the Northern Conservation Area. There is an apparent declining trend in GSM habitat quality and viability within the NGGA. Management of the Northern Conservation Area will improve the overall outcome for GSM in this area. Management will aim to reduce threats and restore habitat values within the Conservation Area of the NGGA to such an extent that the viability of the population improves, and the area is regarded as important to the conservation of the species in the region. Importantly, the management of the whole of the Northern Conservation Area is expected to restore habitat values for GSM in areas currently unoccupied by the species (for example, 550 Elcho Road). Habitat restoration in these areas provides an opportunity to more than compensate for impacts to the species
- Protection and ongoing management of 381.2 ha of GSM habitat outside of the Growth Areas. These external offsets will provide for the protection of native habitat areas known to support GSM within Victoria. These offsets will be strategically located and will identify, protect and manage higher quality areas of GSM habitat which are important to the long-term maintenance and recovery of the species into the future

Altogether, this offset package for GSM is considered to at least compensate for the loss of mostly non-native habitat with the protection and management of native habitat areas.

The offset package delivered under the Plan does not account for potential impacts to habitat within the portion of Heales Road East subject to process based development. Surveys will be undertaken to determine the presence of MNES values in these areas prior to development. Any unavoidable clearing of confirmed areas of GSM habitat within this area will be offset in accordance with the EPBC Act Environmental Offsets Policy and associated Offsets Assessment Guide (Commonwealth of Australia, 2012b). Further details on this process are provided in Section 8.6 of Part 2.

The scale of development under the Plan and assessment through a single Part 10 process under the EPBC Act enables a more strategic approach to offsets compared to those that can be delivered through site-by-site, or Part 9 approval processes. While the ecological benefits of offsets are influenced by a range of factors, there are two key strategic components to the offsets that will be delivered under the Plan which are expected to provide for an improved biodiversity outcome for MNES compared with conventional offsets. These are:

- Coordinated offset delivery within the NGGA: Around 24 per cent of the offset target for GSM will be delivered within the Northern Conservation Area. This is a key outcome of the strategic avoidance planning process, and provides in-situ protection and management of a known population of GSM, local to the areas impacted by development under the Plan
- Spatially planned offsets: Offsets will meet at least one of the following strategic landscape criteria:
    - Protection of GSM habitat areas that would be considered large for the species
    - Located within a key biodiversity corridor and improves connectivity across the landscape
    - Connection of the offset site to an existing conservation reserve

Studies have shown that strategic approaches to offsets such as this, can lead to outcomes that are in the order of 20-40 per cent better than non-strategic offsets (Gordon et al., 2011; Gordon and Peterson, 2019).

19.1.7 OFFSETS TO ADDRESS POTENTIAL IMPACTS ASSOCIATED WITH EXTERNAL INFRASTRUCTURE

Any unavoidable clearing of confirmed areas of GSM habitat within the external infrastructure footprints will be offset in accordance with the EPBC Act Environmental Offsets Policy and associated Offsets Assessment Guide (Commonwealth of Australia, 2012b). Given the existing level of development and land use in these areas, and the need to demonstrate avoidance to the full extent possible under the Plan, the potential level of clearing and associated need for offsets is expected to be minimal.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and draws on the impact analysis presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 17.3 of Chapter 17.

19.1.8 IMPLICATIONS FOR THE SPECIES LONG-TERM VIABILITY AND SUMMARY OF OUTCOMES

A review of the Conservation Advice (DAWE, 2021a) and other key documents have helped to identify the key issues that have the potential to negatively influence the long-term viability of GSM. The issues relevant to implementation of the Plan include loss of habitat and potential indirect impacts associated with weeds and inappropriate fire regimes.

The impact assessment presented here has analysed each of these issues and concluded that:

- Direct impacts to GSM habitat associated with development within the NGGA will lead to residual adverse impacts that will need to be compensated for. The use of offsets to address the residual loss is considered appropriate in the context of:
    - A strong avoidance process which specifically sought to improve the avoidance of GSM values, while balancing social and economic considerations
    - The level of degradation and modification observed across the Growth Areas which reduces the overall conservation benefit of retaining additional areas of GSM habitat
    - The potential indirect impacts associated with the spread of weeds and inappropriate fire regimes are unlikely to be exacerbated under the Plan in a way which has any notable effect on GSM

To summarise the key elements of the assessment for GSM:

- It is unlikely the NGGA would qualify as an important or high quality area as defined by the Conservation Advice (DAWE, 2021a). This conclusion reflects the modified state of the land and extent of weeds which are contributing to a declining trend in values

- The commitments under the Plan relating to the avoidance and offsetting of impacts to GSM habitat are expected to maintain a viable population for the species in both the local area and more broadly through the protection and management of strategic offsets. This will be delivered through:
    - The management and restoration of habitat values within the Northern Conservation Area to the point where habitat condition, extent and therefore the viability of the population, improves and the area is regarded as important to the conservation of the species in the region. In the absence of the strategic assessment, condition of the grassland habitat is likely to continue to decline and the probability of the NGGA GSM population persisting over the long-term is uncertain
    - The delivery of strategic offsets external to the Growth Areas, which will identify, protect and manage higher quality areas of GSM habitat that are likely to be important to maintain the long-term presence of the species across its range into the future

19.1.9 CONSISTENCY WITH RECOVERY PLAN

There is no adopted or made Recovery Plan for this species.

19.1.10 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 19-3 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

Table 19-3: Relevant Key Threatening Processes and associated Threat Abatement Plans for the Golden Sun Moth

Key threatening process	Threat abatement plan
Competition and land degradation by rabbits	Threat abatement plan for competition and land degradation by rabbits (DoEE, 2016a)
Fire regimes that cause declines in biodiversity	There is no relevant TAP
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP

19.2 GROWLING GRASS FROG (*LITORIA RANIFORMIS*)

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, populations and threats. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

Note regarding taxonomic revision of *Litoria raniformis*

In 2023, *Litoria raniformis* was split into two subspecies that are biogeographically and genetically distinct. These are:

- *L. r. raniformis* – the northern lineage
- *L. r. major* – the southern lineage

A revised conservation advice was published for *L. raniformis* at the species level in 2024 (DCCEEW, 2024c).

This impact assessment relates to the southern lineage of Growling Grass Frog (*L. l. major*).

EPBC ACT LISTING	Vulnerable
DESCRIPTION	Growling Grass Frog (GGF) (*Litoria raniformis*) is a large frog that varies in colour from dull olive to bright emerald-green on its back, with large irregular golden-bronze blotches. The skin on the back and sides has numerous warty projections (Clemann and Gillespie, 2012). Females are usually larger (60-104 mm) than males (55-65mm) (DCCEEW, 2024c).
ECOLOGY	This summary of the ecology of GGF relates to the occurrence of the species within the Strategic Assessment Area and surrounds (the southern lineage). The species is mostly aquatic and ground dwelling. It breeds in water and can produce clutches of thousands of eggs (Heard, Scroggie and Clemann, 2010). Tadpoles hatch after 2 – 4 days, and the tadpole stage generally lasts for 3 months though can be much longer (DCCEEW, 2024c). Generational length is estimated to be two years, and breeding starts at one year of age . Breeding typically occurs within spring and summer and does not appear to be reliant upon flooding triggers. Adults may live for four years, although there is low adult survival (DCCEEW, 2024c). The species can be active during both the day and night. Activity peaks in the breeding season (DCCEEW, 2024c). Reduced activity (or torpor) occurs in the colder parts of the year (Heard, Scroggie and Clemann, 2010). GGF is a generalist carnivore and feeds on a variety of small invertebrates and vertebrates. It is known to feed on tadpoles and other frogs (including members of its own species) (DEWHA, 2009c). The species is highly mobile. For example, they have been recorded moving up to 1 km within 24 hours. They are generally recorded within 5 m of the water line, often in the adjacent terrestrial zone or aquatic vegetation (DCCEEW, 2024c). Adult frogs move across areas of open ground to forage and access breeding sites (DEWHA, 2009b). The species will migrate from drying sites to more favourable conditions (DCCEEW, 2024c). The southern lineage of Growling Grass frog tends to show metapopulation structure. This means that (Heard, Scroggie and Clemann, 2010): • The species occurs in metapopulations made up of discrete populations connected by migration • Discrete populations change over time and can go extinct and be recolonised from connected populations
DISTRIBUTION AND HABITAT	***DISTRIBUTION*** GGF is endemic to south-eastern Australia. It was previously one of the most common frogs in the region but has suffered substantial declines in abundance and range (Clemann and Gillespie, 2012).

The two subspecies are geographically distinct, although the exact distribution has not been resolved. The southern lineage has been recorded from south-eastern NSW, eastern and southern Victoria, south-east SA, northern and eastern Tasmania, and King Island. The southern lineage historically occurred in ACT, though is now considered locally extinct (DCCEEW, 2024c).

HABITAT

GGF is a habitat generalist, using a range of slow-moving or still waterbodies. The species is dependent on a matrix of terrestrial and aquatic habitat, and often occurs in areas with both seasonally flooded and permanent waterbodies (DCCEEW, 2024c).

GGF occurs in vegetation within, or at the edges of permanent water including slow-flowing streams, swamps, lagoons, forested wetlands and lakes. The species also occurs in artificial waterbodies in disturbed areas, including farm dams, irrigation channels, and disused quarries. It favours sites with a large proportion of emergent, submerged and floating vegetation, and still or slow-flowing water (DEWHA, 2009c; Clemann and Gillespie, 2012; DCCEEW, 2024c).

During winter torpor, GGF may be located under thick vegetation, rocks, logs and other ground debris. In many areas, torpor occurs in vegetation close to water. The southern lineage is associated with smaller, permanent waterbodies and long periods of metamorphosis. In these areas, frogs can overwinter at considerable distances from waterbodies (Heard, Scroggie and Clemann, 2010; Clemann and Gillespie, 2012; DCCEEW, 2024c).

There is evidence that particular features of waterbodies influence their suitability for breeding habitat for the species. The presence of diverse aquatic vegetation communities likely represents substrates for egg deposition, and tadpole foraging and shelter sites. Permanent wetlands are more likely to be occupied by the species and provide important core breeding habitat, but seasonally flooded ephemeral wetlands can also provide high-quality breeding habitat. Wetlands which are free from predatory fish (particularly introduced fish) are of higher quality as tadpoles are susceptible to predation. Other habitat components include bank-side rocks, open pasture and bare ground, which may also be used during the day for basking activities (DEWHA, 2009c). In addition, wetland occupation is influenced by the size and proximity of neighbouring populations that are spatially discrete, though connected by infrequent dispersal (DCCEEW, 2024c).

The species mostly occurs in freshwater with low turbidity and a neutral pH. It generally does not persist in waterbodies where salinities exceed 7.0 mS/cm for long periods, and numbers decline as salinities approach these levels (Clemann and Gillespie, 2012). However, research has shown that some amount of salinity is important, as it protects the species from susceptibility to chytrid fungus. Environments with moderately saline water may therefore be important for protecting populations from disease threats (DELWP, 2017b).

HABITAT CRITICAL TO THE SURVIVAL OF THE SPECIES

The Recovery Plan notes that it is important to:

> *"…consider habitat critical for survival of* [GGF] *at both a local and a landscape scale, and also consider non-breeding refugia and habitat along dispersal / recolonisation routes."*

The Conservation Advice notes that habitat critical to survival varies between the two subspecies / lineages. The southern lineage is characterised by a metapopulation structure reliant on a network of waterbodies (permanent, ephemeral and semi-permanent) with low vegetation complexity. Waterbodies in a close cluster (around 10, within 700 m) facilitates frog movement and provides a greater colonisation rate. Movement between refuge habitat and breeding sites is critical to maintain genetic diversity, and allow recolonisation following local extinction (DCCEEW, 2024c).

In addition, sites unfavourable to chytrid are critical for the southern lineage. Relevant attributes include relatively warm water, slightly saline or alkaline, and shallows free from tall vegetation (DCCEEW, 2024c).

(Heard, Scroggie and Clemann, 2010) in their research on metapopulation dynamics provide insight about habitat critical to the survival through the identification of the drivers of site level population extinction and recolonisation. They found that:

- Discrete populations are less likely to go extinct where the following habitat characteristics are present:
    - Larger, permanent waterbodies

	○ Increased aquatic vegetation cover ○ Increased landscape scale connectivity • The probability of recolonisation of a discrete population increases with increasing landscape scale connectivity These findings are reflected in both the: • *Growling Grass Frog Habitat Design Standards for the Melbourne Strategic Assessment* (DELWP, 2017b) which provide guidance on protecting and creating the various types of habitat required to support metapopulations of GGF over the long term • *Growling Grass Frog Crossing Design Standards for the Melbourne Strategic Assessment* (DELWP, 2017a) which aim to ensure that crossings for new and widened roads, railway lines and other infrastructure through conservation areas are designed to ensure that GGF will be able to easily move through, so that metapopulation dynamics can be maintained Given the proximity of the MSA to the Geelong Strategic Assessment Area and the likely similarities in key ecological requirements for the species in both locations, both of these guidelines are considered to be a useful resource for this project.
POPULATIONS	As outlined above, there appear to be two distinct biogeographical groups of the species. However, there is limited information available about either the: • Estimated total population size of each group, or • Number of discrete populations or metapopulations within each group The population of GGF has declined substantially since the 1980s. The distribution of the southern lineage has shrunk, and the species has disappeared from the ACT and much of NSW. Isolated subpopulations remain in NSW. A number of remnant sites across Victoria have been lost between 2012-2022, including the last remaining sites in the northeast, and in areas around Melbourne and Geelong (DCCEEW, 2024c). The GGF Significant Impact Guidelines (DEWHA, 2009c) define what an 'important' population is for the species. The guidelines state: *"…any viable population is considered to be an important population for the persistence and recovery of the growling grass frog."* *"…a viable population is one which is not isolated from other populations or water bodies, such that it has the opportunity to interact with other nearby populations or has the ability to establish new populations when water bodies fill and become available."* *"In addition, a population of growling grass frogs could be considered an important population if it is near the limit of the species range (for example small, isolated populations in South Australia), is well-studied or has a history of monitoring, and hence provides opportunity for greater understanding of the species through the collection of long-term data."*
THREATS	The GGF Significant Impact Guidelines (DEWHA, 2009c) identify the threats most relevant to decision making under the EPBC Act. They are: • Habitat loss, degradation and modification caused by: ○ Draining, infilling or changes to flooding patterns of permanent and non-permanent water bodies, or their adjoining watercourses and surrounding vegetation ○ Alteration of wetland hydrology, diversity and structure ○ Removal of aquatic vegetation ○ Clearing of terrestrial vegetation, fallen logs and ground debris surrounding water bodies ○ Deterioration of water quality and any introduction of pollutants and biocides ○ Introduction of domestic stock or feral animals (for example rabbits, goats and pigs) causing damage to banks or terrestrial habitat • Fragmentation and isolation of populations caused by construction of barriers that limit frog movements between waterbodies (for example buildings, fences, roads, industrial estates etc)

	• Introduced predators and disease caused by the introduction of:
	  ○ Exotic fish species
	  ○ Feral predators such as foxes and cats
	  ○ The chytrid fungus
	These threats are consistent with those identified in the GGF Recovery Plan (Clemann and Gillespie, 2012) and Conservation Advice (DCCEEW, 2024c). Although the Recovery Plan also identifies exposure of frogs to harmful levels of ultraviolet-B radiation (due to anthropogenic depletion of the ozone layer) as an additional threat. Additionally, the Conservation Advice identifies increased frequency and severity of fire, and increased severity of droughts associated with climate change as threats to GGF (DCCEEW, 2024c).
	The widespread declines and localised extinctions experienced by the species, and the uncertainty surrounding the causes of these declines, suggests that no extant population should be considered secure. Loss of populations due to habitat destruction or disease incursion have been known to occur very rapidly (Clemann and Gillespie, 2012).

RELEVANT PLANS AND POLICIES	National Recovery Plan for the Southern Bell Frog *Litoria raniformis* (Clemann and Gillespie, 2012) Conservation Advice for *Litoria raniformis* (Southern Bell Frog) (DCCEEW, 2024c) Threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis (2016) (DoEE, 2016b) Threat abatement plan for predation by the European red fox (DEWHA, 2008e) Threat abatement plan for predation by feral cats (DoE, 2015c)
SPECIES-SPECIFIC GUIDELINES	***COMMONWEALTH*** EPBC Act Policy Statement 3.14: Significant impact guidelines for the vulnerable growling grass frog (*Litoria raniformis*) (DEWHA, 2009b) Background Paper to EPBC Act Policy Statement 3.14: Significant impact guidelines for the vulnerable growling grass frog (*Litoria raniformis*) (DEWHA, 2009c) Survey Guidelines for Australia's Threatened Frogs. EPBC Act survey guidelines 6.3 (DEWHA, 2010) ***STATE*** Growling Grass Frog Masterplan for Melbourne's Growth Corridors Melbourne Strategic Assessment (DELWP, 2017c) Growling Grass Frog Habitat Design Standards Melbourne Strategic Assessment (DELWP, 2017b) Growling Grass Frog Crossing Design Standards Melbourne Strategic Assessment (DELWP, 2017a)
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1828

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *An overview of the habitat mapping for the species within and outside the Growth Areas*
- *An overview of the population mapping for the species*

Please refer to Chapter 13 for further details about the approach to threatened species baseline data, including a description of the different types and sources of data, as well as some discussion on the interpretation and suitability of the data for use in the impact assessment.

HABITAT MAPPING	**WITHIN THE SURVEYED AREAS OF THE GROWTH AREAS** Habitat mapping for GGF within the surveyed areas of the growth areas is based on EHP survey results (EHP, 2021). The species was recorded within Cowies Creek during targeted surveys, and the native vegetation along Cowies Creek has been mapped as habitat for the species.

	WITHIN THE UNSURVEYED AREAS OF THE GROWTH AREAS
	There is no potential habitat for GGF in the unsurveyed areas of the growth areas.
	OUTSIDE THE GROWTH AREAS
	Habitat mapping across the broader Strategic Assessment Area and Study Area was based on the GGF HIM prepared by DELWP (DELWP, 2017d).
POPULATION MAPPING	**RECORD SELECTION**
	Species records were compiled from the following sources: • The VBA. Records were filtered to remove records prior to 1990 for the purpose of the impact assessment • Surveys undertaken by EHP for the Strategic Assessment (EHP, 2021), and for an individual landholder in the WGGA (EHP, 2025) • A report by Beacon Ecological (Beacon Ecological, 2010) • Surveys by the Victorian Government Department of Justice and Community Safety (DJCS, 2023) • A site inspection by Tactecol Consulting (Tactecol consulting, 2025) • Additional records collected by the City of Greater Geelong at Fyansford
	RECORD DOWNLOAD DATE
	VBA records for GGF used in this assessment were downloaded in February 2025.
	POPULATION DEFINITION
	For the purposes of this Strategic Assessment Report, the following definitions are applied to GGF: • Population: a group of GGF present at a discrete wetland site • Metapopulation: multiple populations connected by migration (DELWP, 2017b)

OCCURRENCE IN THE STUDY AREA

This section describes the occurrence of the species in the Study Area. It includes reference to maps of records and habitat which can be viewed as separate files. The maps provide critical context for the assessment and should be viewed in conjunction with the text presented in this assessment.

GGF occurs within Cowies Creek in the Strategic Assessment Area (including within the WGGA) and in a variety of other locations throughout the broader Study Area. There is no suitable habitat for the species in the NGGA and it is not present in that growth area.

See Map 19-4 for a map of GGF records and habitat in the Cowies Creek corridor, and Map 19-5 for records and modelled habitat across the broader Study Area.

19.2.1 OCCURRENCE WITHIN THE STRATEGIC ASSESSMENT AREA

OCCURRENCE IN THE COWIES CREEK CORRIDOR

Cowies Creek supports an important metapopulation of GGF both within and downstream of the WGGA. See below for discussion.

Cowies Creek within the WGGA

Cowies Creek within the WGGA runs along the northern border of the Creamery Road Precinct. The northern boundary of the precinct is near a railway line and the creek occurs close to the line on a number of occasions.

EHP (EHP, 2021) carried out targeted surveys for the strategic assessment along Cowies Creek in the WGGA on two occasions (6 December 2019 and 12 January 2020). They recorded approximately 50 individuals across four sites. EHP considered that the area supported an important population (particularly because it contained a range of key habitat attributes) and that Cowies Creek was an important habitat corridor through the growth area.

GGF was also recorded in the Cowies Creek corridor in 2022 by Tactecol Consulting. A site inspection was undertaken on the 23rd February 2022. During this inspection, at least 6 juvenile frogs were observed in Cowies Creek. These individuals were considered to have metamorphosed recently, and are assumed to be the result of successful breeding in the 2021-22 breeding season in Cowies Creek (Tactecol consulting, 2025).

Further surveys by EHP in Cowies Creek in the WGGA were undertaken on three nights in February and March of 2024. Four individuals were recorded during surveys. EHP concluded that these records are likely part of the broader Cowies Creek population recorded in 2019 and 2020 by EHP (as above) (DJCS, 2023).

AECOM (AECOM, 2021) described the habitat within Cowies Creek in the WGGA. The following description is drawn from that report:

- The creek includes the following aquatic habitat features:
    - A number of open, still or slow flowing pools that support GGF breeding habitat features including fringing emergent and floating vegetation (see Figure 19-1). The four sites where EHP recorded the species were open pools, and there are a number of other pools along the creek that support similar features
    - Sections that are densely vegetated with reeds (see Figure 19-2). These areas are not considered optimal for breeding but are likely to provide dispersal and overwintering habitat
    - Some sections that are showing signs of erosion
- Terrestrial habitat around the creek is comprised of a number of agricultural properties that are all heavily modified due to cropping and grazing (see Figure 19-3 and Figure 19-4). There are no offline wetlands, and it appears that there are little to no rocks or logs which would provide overwintering habitat

Cowies Creek downstream of the WGGA

GGF has also been recorded downstream of the WGGA within Cowies Creek on a number of occasions, between the Geelong Ring Road and Thomspon Road. GGF has not been recorded further downstream than Thomspon Road. These records appear to have some level of connectivity with the frogs in the WGGA and are likely to form part of a larger, connected metapopulation.

The species was first recorded downstream of the WGGA as part of surveys (Beacon Ecological, 2009) commissioned by the City in 2009 for a proposed water storage dam within the Cowies Creek Reserve. Beacon Ecological initially recorded two to three individuals of the species within the creek corridor (noting that surveys were undertaken in winter when the frog is least active). The project was referred under the EPBC Act (EPBC 2009/5001) and was determined to be a non-controlled action if undertaken in a particular manner.

As part of a requirement of the EPBC referral decision, Beacon Ecological carried out further GGF surveys in December 2009 and January 2010 (Beacon Ecological, 2010). They recorded the species at eight different sites, including more than 40 individuals at one site. The majority of the records were found between the Geelong Ring Road (close to the WGGA) and the Corio Leisure Centre on Anakie Road. The species was recorded at one site downstream of Anakie Road.

The species was also recorded more recently in the following locations:

- Further downstream of Anakie Road towards Thompson Road, in 2020. A total of 3 frogs were recorded (VBA records)
- Upstream of Anakie Road, on the 11th February 2023. A total of 8 individuals were recorded on this occasion (DJCS, 2023)

These more recent records suggest that the species is persisting in the creek corridor.

The habitat downstream of the WGGA is mostly instream habitat. However, there are two to three offline wetlands within this part of the corridor that appear to have records of the species.

Cowies Creek upstream of the WGGA

There are no records of the species upstream from the WGGA and that area appears to have much more limited GGF habitat values due to historic land use. It is considered less likely that the species is present in this location on a permanent basis.

Cowies Creek metapopulation

The number and location of GGF records within Cowies Creek suggests that the corridor supports an important, connected metapopulation of the species. Records stretch for more than 3.5 km along the creek and suitable habitat extends beyond this distance. AECOM (2025) also note that population persistence during the prolonged millennium drought in 2009 / 2010 indicates that Cowies Creek may act as a drought refuge for the species.

The available information suggests that the Cowies Creek metapopulation is comprised of a range of discrete, breeding populations of GGF that are connected along the creek corridor. This is supported by (AECOM, 2025) who suggested that the Cowies Creek metapopulation consists of five distinct clusters - noting that the report does not consider more recent records by EHP (EHP, 2025), Tactecol Consulting (Tactecol Consulting, 2025), or the Department of Justice and Community Safety (DJCS, 2023). Despite previous development in the area the species is persisting and metapopulation dynamics appear to still be operating.

AECOM (2021) identified the existing threats to the Cowies Creek metapopulation. They include:

- Habitat degradation: the majority of terrestrial habitat along the creek has been substantially modified due to agricultural practices and nearby development. There is limited suitable overwintering habitat in many parts of the corridor. In addition, some parts of the creek are affected by weeds and/or erosion
- Existing development and encroachment: nearby development places a range of pressures on habitat within the corridor including artificial lighting, access by people, and potential issues associated with pollution
- Pests and disease: AECOM thought that it was likely that chytrid fungus is already present within Cowies Creek. They also suggested that the metapopulation would be under pressure from cats, foxes and the mosquito fish
- Metapopulation dynamics: given the limited availability of offline habitat within the Cowies Creek corridor, the metapopulation may be sensitive to any adverse impacts to the instream habitats

Tributary to Cowies Creek within the Creamery Road Precinct

The Creamery Road Precinct also includes a small tributary of Cowies Creek (running south-west from the north-east corner of the precinct). The draft Conservation Management Plan (CMP) for the Cowies Creek Conservation Area (Biosis, 2024a) (see Section 19.2.4 below) states that the tributary is unlikely to provide breeding habitat for GGF. It is narrow and incised and on a steep gradient such that surface water flows are likely to occur only in the immediate period after rainfall events and open-water pools will not occur or persist. (AECOM, 2025) were also of the view that the tributary is mostly dry with no standing or flowing water. They noted that there is minimal shelter (logs or rocks), and opportunities for population movement or expansion are limited at present.

Figure 19-1: Open pool along Cowies Creek (taken from (AECOM, 2021)

Figure 19-2: Section of Cowies Creek dominated by reeds and spiny rush (taken from (AECOM, 2021)

Figure 19-3: Cropped area adjacent to Cowies Creek (taken from (AECOM, 2021)

Figure 19-4: Steep rocky slope with scattered native grasses (taken from (AECOM, 2021)

OCCURRENCE IN OTHER PARTS OF THE STRATEGIC ASSESSMENT AREA

Beyond Cowies Creek, GGF has not been recorded within the Strategic Assessment Area.

It is worth noting that within the WGGA, EHP (EHP, 2021) stated that there is a low-moderate likelihood of an extant population occurring along the Moorabool River. However, they carried out surveys on three occasions (13th December 2019, 26th and 28th February 2020) in that location and did not identify any frogs. The survey effort was designed to provide a 99 per cent chance of detecting the species (if it was present) based on the survey protocols set out in (Heard, Scroggie and Clemann, 2010).

19.2.2 OCCURRENCE WITHIN THE BROADER STUDY AREA

There are at least five records of GGF within the Moorabool River near Fyansford, close to the confluence with the Barwon River. These records are hydrologically connected to the Growth Areas, occurring approximately 9 km downstream. There are currently barriers within the Moorabool River which would likely prevent movement of frogs upstream towards the WGGA. However, if these barriers are removed and there is restoration along the river corridor as part of future development, these records may form a source population which would allow upstream stretches of suitable habitat to be occupied.

Records also occur in the Lake Connewarre complex, with a number of associated records occurring upstream in the Barwon River. While relatively distant, some of these records are hydrologically connected to the growth areas.

Within the broader Study Area there are more than 1,100 records of GGF. These are heavily concentrated in the Werribee/Avalon area of the Port Philip Bay and Bellarine Peninsula Ramsar Site, with some associated records occurring to the north and north-west of that location. These records are not hydrologically connected to the growth areas.

19.2.3 POTENTIAL DISPERSAL BETWEEN CATCHMENTS

The topography, existing land use and isolated nature of Cowies Creek means there is little or no existing capacity for GGF to disperse to habitats within other catchments (see Map 19-5). In particular, Biosis fauna ecologists considered it unlikely that there is existing connectivity from the Moorabool River to Cowies Creek via the unnamed tributary in the Creamery Road Precinct (even during wet periods). This is largely due to the:

- Distance of more than 2.2 km between Cowies Creek and the Moorabool to the south, and 1.3 km between the upper end of the unnamed tributary and the Moorabool river. Heard, Scroggie and Malone (2012) documents poor dispersal capacity over distances greater than 500 m between suitable waterbodies, with populations separated by 500 m having limited influence on each other's dynamics
- Presence of existing roads, which present a significant dispersal barrier. This includes Ballarat Road in the south, which is a major thoroughfare that is heavily trafficked
- Topography including a steep climb north of the Moorabool towards the Creamery Road Precinct, and the steep, incised nature of the unnamed tributary making it generally unsuitable habitat for GGF
- Existing land use which is largely inhospitable to GGF including agricultural land use, residences, and a number of sealed and unsealed roads

IMPACT ANALYSIS

This section analyses the potential impacts to the species. It:

- *Presents the proposed Cowies Creek Conservation Area within the WGGA and discusses what it is aiming to achieve for GGF*
- *Presents GGF habitat enhancements that will be undertaken in Cowies Creek downstream of the WGGA*
- *Analyses the potential indirect impacts to GGF from development within the WGGA*

The Plan includes an outcome to support the long-term viability of GGF along Cowies Creek through the protection and enhancement of habitat. The key commitments to deliver this outcome are the:

- Establishment of the Cowies Creek Conservation Area (Commitment 9)
- Preparation and implementation of a Conservation Management Plan for the Cowies Creek Conservation Area (Commitment 10), and

- Enhancement of habitat in Cowies Creek downstream of the WGGA (Commitment 11)

19.2.4 COWIES CREEK CONSERVATION AREA

Establishment of the Cowies Creek Conservation Area will ensure that there will be no direct impacts to GGF and that a significant area of habitat is restored and managed (see Map 19-6 for an indicative layout). This section sets out the aims of the conservation area, how it will be implemented in relation to GGF, and what success looks like for the GGF within the conservation area.

AIMS OF THE CONSERVATION AREA

The Cowies Creek Conservation Area will be established in the WGGA in order to:

- Protect and regenerate biodiversity values along the creek corridor. This supports one of the Framework Plan's (The City of Greater Geelong, 2021b) urban development objectives which identifies Cowies Creek as a priority for that purpose
- Protect cultural heritage values. There are a range of sites of cultural heritage significance in the creek corridor and the conservation area will provide a level of protection for these. This supports the same urban development objective in the Framework Plan as the one that relates to biodiversity
- Provide for some social infrastructure within the precinct that is sympathetic to the protection of biodiversity and heritage values. Social infrastructure may include walking trails and some open space facilities

In relation to GGF, the conservation area will support the persistence of the species within the WGGA and aims to maintain the metapopulation dynamics with the broader Cowies Creek metapopulation downstream. It will do this by:

- Protecting high quality instream habitat
- Helping to improve the condition of lower quality instream habitat
- Protecting terrestrial habitat in buffer areas adjacent to the creek
- Regenerating areas of terrestrial habitat that are degraded through historical land uses
- Providing for the creation of off-stream habitat

HOW THE CONSERVATION AREA WILL BE IMPLEMENTED IN RELATION TO GGF

This section discusses how the Cowies Creek Conservation Area will be implemented in relation to GGF. It does not talk to other issues relating to the conservation area such as the protection and management of cultural heritage values which are dealt with through other regulatory processes.

The key guiding documents for designing and managing the conservation area in relation to GGF are:

- The Commonwealth's Environmental Management Plan Guidelines (DoE, 2014) which will provide the over-arching framework for the conservation area
- Two design standards for GGF which are best practice for the species:
  - GGF Habitat Design Standards (DELWP, 2017b)
  - GGF Crossing Design Standards (DELWP, 2017a)

Layout of the conservation area

The layout of the conservation area will be finalised through the precinct structure planning process for the Creamery Road precinct. This will involve only minor changes to the indicative boundary, and there is a measure relating to Commitment 9 that ensures "the conservation area includes all areas of habitat that may be needed to support the continued persistence of the Growling Grass Frog within the WGGA, including areas of habitat that may be used for breeding, foraging and movement".

One of the key considerations in finalising the layout will include maintaining an appropriate corridor width to protect terrestrial habitat and buffer the instream habitat. It is noted that the GGF Significant Impact Guidelines (DEWHA, 2009c):

- Identify permanent removal or degradation of habitat within 200 m of a water body as a likely significant impact to the species

- Recommend that buffer zones of at least 200 m around water bodies and dedicated terrestrial habitat corridors of at least 100 m be retained

The topography of Cowies Creek and current land use within the Creamery Road Precinct is not conducive to a buffer distance of 200 m. There is a significant break of slope at approximately 100 m from the creek line which is likely to represent the edge of the potential terrestrial habitat for the species. Beyond the break of slope there are significant areas of cropping and a lack of suitable habitat. This suggests that a layout that is based on the break of slope as the edge of the conservation area is appropriate. This would maintain an average corridor width of approximately 100 m from the stream and given the current use of Cowies Creek by the species is considered appropriate for the long term protection of the population in the WGGA.

The decision on the layout would also give consideration to the ephemeral unnamed tributary that runs into Cowies Creek in the precinct, and the potential for that area to provide additional habitat for the species.

Conservation Management Plan

The Plan commits to the development and implementation of a Conservation Management Plan for the conservation area. The Conservation Management Plan will be prepared to give effect to the aims of the conservation area (discussed above) and in accordance with the GGF Habitat Design and Crossing Standards (DELWP, 2017b, 2017a). It will include the following for GGF:

- The boundary of the conservation area
- Native vegetation to be retained as identified in the NVPP
- GGF records and habitat
- Any locations suitable for public access points, walking paths/trails, and passive recreation
- Any locations suitable for water management assets and associated infrastructure
- Management actions and arrangements to protect GGF and its habitat, including management methods, standards and techniques, roles and responsibilities, timing for implementation, funding, monitoring, and reporting. This includes:
    - Protecting high quality instream habitat
    - Improving the condition of lower quality instream habitat
    - Protecting terrestrial habitat in buffer areas adjacent to the creek
    - Regenerating areas of terrestrial habitat that are degraded
    - Providing for the creation of off-stream habitat, where appropriate and beneficial to the species
- Monitoring processes to allow for adaptive management of the CMP, including population monitoring for Growling Grass Frog in Cowies Creek

A draft Conservation Management Plan has been prepared by Biosis (Biosis, 2024a), and is in the process of being finalised.

Given the currently degraded state of habitat in the creek corridor (particularly the terrestrial areas), there are significant opportunities to improve the condition of habitat for GGF within the conservation area. Rehabilitation and regeneration of habitat will be a priority of the Conservation Management Plan.

A key component of the Conservation Management Plan will be the sensitive design of any social infrastructure (e.g., walking paths) or water infrastructure to ensure that impacts to GGF are avoided. Any crossings of Cowies Creek will be designed in accordance with the GGF Crossing Standards (DELWP, 2017a).

Ongoing monitoring of the species within the conservation area will be important to ensure that performance of the Conservation Management Plan is understood, and to ensure that management is responsive and adapts to any changing circumstances.

WHAT DOES SUCCESS LOOK LIKE FOR THE GGF IN THE COWIES CREEK CONSERVATION AREA?

The Cowies Creek Conservation Area will be a success for GGF if:

- The population persists and remains viable over the long term
- Habitat is retained and its condition improves over time

- Metapopulation dynamics are retained with downstream populations of the species
- Conservation works contribute to increased population resilience

19.2.5 ENHANCEMENT OF HABITAT IN COWIES CREEK DOWNSTREAM OF THE WGGA

To further support the metapopulation of GGF within Cowies Creek, the Plan commits to enhancing habitat downstream of the WGGA to support the:

- Long-term viability of the Cowies Creek metapopulation of Growling Grass Frogs
- Persistence of the species within the WGGA

There are a range of opportunities to improve habitat for the species in the area downstream of the WGGA. The specific works will be confirmed through a detailed design process, and documented in the Cowies Creek Conservation Management Plan, but are likely to include:

- The creation of one or more off-line wetlands to create habitat for the species
- Vegetation management to improve habitat quality for the species
- Revegetation and bank stabilisation
- Infrastructure changes to improve connectivity for the species under the Bluestone Bridge along Cowies Creek

These works will add resilience to the metapopulation and support the objectives of the Cowies Creek Conservation Area for the species.

19.2.6 POTENTIAL INDIRECT IMPACTS

This section analyses the relevant potential indirect impacts to GGF that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in the recovery plan or significant impact guidelines for GGF, and*
- *The Plan has the potential to introduce or exacerbate the threat*

Please note that Chapter 17 provides a detailed discussion and analysis of the indirect impacts that may occur as a result of implementing the Plan and the associated mitigation measures. It is critical to read Chapter 17 in order to understand the conclusions reached in this section.

The relevant potential indirect impacts to GGF are:

- Habitat degradation and/or modification caused by:
  - Changed hydrological regimes
  - Deterioration of water quality and any introduction of pollutants and biocides
- Fragmentation and isolation of populations
- Introduction of cats

There are a number of additional threats to the species identified in the Recovery Plan and GGF Significant Guidelines. However, potential indirect impacts to the species associated with these threats are considered unlikely as a result of development under the Plan. Refer to Section 17.2 of Chapter 17 for a detailed assessment of potential indirect impacts associated with the implementation of the Plan.

Climate change is also identified as a threat to the species. The potential impacts of climate change and relevant mitigation measures under the Plan are outlined in Section 29.5 of Chapter 29.

HABITAT DEGRADATION/MODIFICATION: CHANGED HYDROLOGICAL REGIMES

Changed hydrological regimes have the potential to impact GGF by altering the nature of habitat for the species and making it unsuitable. This can relate to both water quantity and the rate that it flows.

In Cowies Creek, all of the aquatic habitat in the WGGA occurs as still or slow flowing instream pools, and the majority of habitat downstream of the growth area is also instream. The lack of off-stream habitat makes the Cowies Creek metapopulation particularly sensitive to hydrological changes as any significant alteration to flows has the potential to affect the instream areas.

Development under the Plan has the potential to alter hydrological regimes through the creation of hard surfaces and the need to manage stormwater that is generated from developed areas. Cowies Creek is hydrologically connected to development within parts of the Growth Areas (see Map 3-10).

The Plan proposes to manage stormwater through the preparation of Integrated Water Management strategies for each precinct. These strategies are prepared as part of the precinct planning process and set out how water is managed. Key components of these strategies in relation to GGF include:

- Consideration of downstream biodiversity values
- Management of water quantity and flow rates
- Management of water quality (discussed further below)
- Location of water infrastructure and water outflows

Concept designs have been completed for the Creamery Road Precinct for the management of stormwater (Alluvium, 2022). Further work is required to finalise these plans. However, the concept designs:

- Provide an indication of the number and location of water management assets (see Map 19-7, taken from (Alluvium, 2022)
- Establish that water quantity will be managed to protect downstream environmental values. This typically involves ensuring that stormwater runoff rates are no greater than the pre-development 1 in 100 year peak flow rates. It should be noted that while the rates are not expected to be higher than pre-development rates, the overall quantity of water entering Cowies Creek is expected to increase due to the creation of hard surfaces and the reductions in infiltration. This would mean that water flows more regularly into the creek

A similar process will be used for development in the part of the NGGA that is hydrologically connected to Cowies Creek. Although it is noted that these areas are further removed from GGF habitat and the potential impacts to habitat for the species are likely to be more diffuse.

The implementation of Integrated Water Strategies that are designed with the aim of protecting habitat for GGF is considered an appropriate mitigation approach in relation to hydrological regimes. However, given the overall quantity of water flowing into Cowies Creek will increase there is some outstanding risk that instream habitat will be negatively affected. It will be critical as part of implementing the Conservation Management Plan for the Cowies Creek Conservation Area that monitoring considers any potential impacts to habitat quality, and if necessary, contingency measures are applied to better manage water flows.

In addition, the creation of off-line habitat for the species both within and downstream of the WGGA will be a critical measure for protecting the species, and improving the resilience of the Cowies Creek metapopulation.

HABITAT DEGRADATION/MODIFICATION: DETERIORATION OF WATER QUALITY

Amphibians are particularly susceptible to the impacts of pollutants due to their semi-permeable skin, and GGF is likely to be susceptible to the impacts of pollutants in waterways (Clemann & Gillespie, 2012). Increased sediment load and water pollution from run off from urban development and primary industries is known to have negative consequences for tadpole and egg development. In addition, it is suspected that glyphosate herbicides have contributed to the species decline in the past (DCCEEW, 2024c).

Development under the Plan has the potential to reduce water quality through:

- Sediment and other materials entering Cowies Creek during the construction phase of development
- The introduction of pollutants into stormwater

All relevant development under the Plan will require sediment and erosion control plans to ensure sediment is appropriately managed during construction. These will be implemented through the standard development application processes and are considered appropriate for mitigating the risk to GGF.

Stormwater quality entering Cowies Creek will be managed through the Integrated Water Management strategies prepared for each precinct. The concept designs for the Creamery Road Precinct (Alluvium, 2022) set out that water quality needs to meet the Urban Stormwater Best Practice Environmental Management (BPEM) Guidelines (CSIRO, 1999) pollution reduction targets. These targets are:

- 70 per cent removal of the Total Gross Pollutant load
- 80 per cent removal of Total Suspended Solids (TSS)
- 45 per cent removal of Total Nitrogen (TN)
- 45 per cent removal of Total Phosphorus (TP)

As per the management of water quantity, the implementation of Integrated Water Strategies that are designed with the aim of protecting habitat for GGF is considered an appropriate mitigation approach in relation to water quality. However, monitoring of water quality as part of implementing the Conservation Management Plan for the Cowies Creek Conservation Area will be important, and if needed, contingency measures to better manage water quality will need to be applied.

FRAGMENTATION AND ISOLATION OF POPULATIONS

Fragmentation and isolation of GGF populations is a critical threat to the species. As outlined previously, GGF is dependent on metapopulation dynamics and in particular connected landscapes to allow those dynamics to operate. It is noted that the key connection for the species relates to the reach of Cowies Creek, and that it is considered unlikely that the metapopulation is connected to other catchments.

Development under the Plan has the potential to fragment the Cowies Creek metapopulation if the measures to manage hydrological changes and/or water quality are not successful. This places additional emphasis on the need to manage those issues appropriately and maintain a functioning metapopulation of GGF along Cowies Creek.

INTRODUCTION OF CATS

Feral cats and European red foxes are likely to prey on the species throughout its distribution (DCCEEW, 2024c). Cats are known to be effective predators of amphibians, and this threat may be particularly relevant to populations which are already suppressed by other threatening processes (Clemann & Gillespie, 2012).

This potential impact is most relevant to the Cowies Creek Conservation Area, where an increase in nearby housing has the potential to increase the prevalence of domestic and feral cats interacting with the GGF population.

However, cats are likely to already be prevalent in the strategic assessment area due to the level of existing development. This includes locations to the north of Cowies Creek in the WGGA, and downstream areas of Cowies Creek.

Management of the Cowies Creek Conservation Area in accordance with a Conservation Management Plan will address any key threats operating on the GGF population. Should cat predation become an increased issue that adversely affects the population, this will be identified through monitoring and suitable cat management arrangements will be put in place. These processes are expected to adequately address the potential indirect impacts associated with any increase in the prevalence of cats.

OFFSETS TO COMPENSATE FOR RESIDUAL ADVERSE IMPACTS

This section identifies any offsets needed to address residual adverse impacts to listed threatened species.

Residual adverse impacts to GGF are not expected based on the implementation of the Cowies Creek Conservation Area, the habitat enhancement works to be undertaken downstream of the WGGA, and the proposed mitigation measures set out in the Plan and BCS to address indirect impacts. On this basis, offsets are not required for the species. However, there remain some residual risks to the species persisting in the long term in the presence of additional urban development.

The Plan commits to regular monitoring of the Cowies Creek metapopulation both within the WGGA and on the land downstream. In the case that declines in the population are observed, the priority will be undertaking further actions to protect and restore the population in Cowies Creek. The BCS sets out the following process if declines are observed:

- If necessary, the City will instigate further information gathering to try and determine the causes of the declines
- Restorative actions will be determined based on the causes of any declines. These may include measures such as:
    - Changes to how water quantity and/or quality are managed
    - Management actions in the corridor to restore habitat
- Monitoring intensity will be increased to determine if the restorative actions are working

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Recovery Plan and draws on the impact analysis presented above.

This section also discusses the consistency of the Plan with the Recovery Plan and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 17.3 of Chapter 17.

19.2.7 IMPLICATIONS FOR THE SPECIES LONG-TERM VIABILITY AND SUMMARY OF OUTCOMES

An important population of GGF occurs within Cowies Creek within and downstream of the WGGA.

Development under the Plan will not impact the species directly. The assessment presented here analysed the potential for the species to be impacted indirectly as a result of potential changes in hydrology, water quality, fragmentation, and the introduction of cats. It was concluded that the range of commitments in the Plan and measures in the BCS are expected to adequately protect the species from these potential impacts. In particular, the establishment and management of the Cowies Creek Conservation Area and habitat enhancement works downstream of the WGGA will be important for ensuring GGF persists in the strategic assessment area.

In this way, development under the Plan is unlikely to adversely influence the long-term viability of GGF.

19.2.8 CONSISTENCY WITH THE RECOVERY PLAN

In accordance with Section 146K of the EPBC Act, this section considers whether the implementation of the Plan is not inconsistent with the species' Recovery Plan. It considers two questions:

- Does the Plan prevent achievement of the objectives of the Recovery Plan?
- Does the Plan prevent implementation of the Recovery Plan actions?

These questions are discussed below.

DOES THE PLAN PREVENT ACHIEVEMENT OF THE OBJECTIVES OF THE RECOVERY PLAN?

The overall long-term objective of the Recovery Plan is to achieve a down-listing of GGF from Vulnerable to a lower threat category based on the IUCN 2001 Red List categories and criteria. This overall objective is associated with a series of specific objectives (Clemann & Gillespie, 2012):

1. Secure extant populations of [GGF], particularly those occurring in known breeding habitats, and improve their viability through increases in size and / or area of occurrence
2. Determine distribution, biology and ecology of the [GGF], and identify causes of the decline of the species across its geographic range
3. Address known or predicted threatening processes, and implement appropriate management practices where possible to ensure that land use activities do not threaten the survival of the [GGF]
4. Increase community awareness of and support for [GGF] conservation

Development under the Plan will not prevent the achievement of any of the objectives of the Recovery Plan. In addition, the commitments in the Plan will support the specific objectives (particularly Objective 1) by:

- Improving the protection of the species within Cowies Creek
- Aiming to improve the condition of habitat within Cowies Creek

DOES THE PLAN PREVENT IMPLEMENTATION OF THE RECOVERY PLAN ACTIONS?

The Recovery Plan identifies a set of actions in order to deliver on the objectives. Each action is associated with performance criteria (Clemann & Gillespie, 2012). The Plan will not prevent the implementation of any of these actions, nor will it prevent the achievement of any of the performance criteria.

19.2.9 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 19-4 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

Table 19-4: Relevant Key Threatening Processes and associated Threat Abatement Plans for GGF

Key threatening processes	Threat abatement plan
Land clearance	There is no relevant TAP
Infection of amphibians with chytrid fungus resulting in chytridiomycosis	Threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis (DoEE, 2016b)
Novel biota and their impact on biodiversity	There is no relevant TAP
Predation by feral cats	Threat abatement plan for predation by feral cats (DoE, 2015c)
Predation by the European red fox	Threat abatement plan for predation by the European red fox (DEWHA, 2008e)

19.3 STRIPED LEGLESS LIZARD (*DELMA IMPAR*)

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, populations and threats. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable Note that the Striped Legless Lizard is currently on the Finalised Priority Assessment List (FPAL) and is proposed to have its listing upgraded to Endangered (DAWE, 2021b). A decision is due by 30 October 2026 (DAWE, 2021b).
DESCRIPTION	Striped Legless Lizard (SLL) (*Delma impar*) is a small reptile in the Pygopodidae family. The SLL lacks forelimbs and has reduced vestigial hind limbs. It has considerable variation in colour and pattern, with a pale grey-brown dorsal, cream ventral, and dark brown or blackish dorsolateral with stripes along the length of the tail and body (TSSC, 2016a). The species can reach a total length of 300 mm (DSEWPC, 2011).
ECOLOGY	SLL is a long-lived species with estimates of lifespan beginning at 10 years, though individuals may live significantly longer. Age of first reproduction is thought to be 2-3 years for males, and 3-4 years for females (TSSC, 2016a). The species feeds on spiders, crickets, grasshoppers, *Lepidopteran* larvae and cockroaches (TSSC, 2016a). It predominantly uses active searching foraging methods, though may also use ambush methods. Foraging methods alter according to prey type (DCCEEW, 2022). Females are capable of breeding every year and lay two eggs in a soil cavity or under a rock. Nests are communal and contain up to 36 eggs. Repeated use of communal nests has been recorded. Eggs are laid in December – January and hatch in January – February (TSSC, 2016a) after an incubation period of around 50 days (Parks Victoria, 2022f). SLL is active during the day from late spring to early autumn, with a peak in activity in November and December (DSEWPC, 2011). The species shelters in grass tussocks, thick ground cover, soil cracks, under rocks, spider burrows, and under debris such as timber. The species enters a state of reduced activity (or torpor) during the winter months, overwintering in soil cracks, under bed rocks, and in tussock bases (DCCEEW, 2022).
DISTRIBUTION AND HABITAT	***DISTRIBUTION*** SLL was formerly distributed throughout temperate lowland grasslands in the ACT, the south-western slopes and southern tablelands of NSW, central and southern Victoria, and the south-eastern corner of SA. The species distribution has declined, with many known sites no longer supporting populations. The range of the species within Victoria appears to have contracted to the southern part of the state (DCCEEW, 2022). The Strategic Assessment Area is towards the southern extent of the species known range. ***HABITAT*** The species is a grassland specialist and is only found in areas of native grassland and nearby grassy woodland and exotic pasture (TSSC, 2016a). Occupied sites have a grassy groundcover, with a mixture of native and exotic perennial and annual species of tussock-forming grasses. The species was thought to only occur in native grasslands dominated by Spear Grass (*Stipa* bigeniculata) and Kangaroo Grass (*Themeda triandra*). However, the species is now known to occur in some areas dominated by introduced species including *Phalaris aquatica*, Serrated Tussock (*Nasella trichotoma*) and *Hypocharis radicata*, and at sites with a history of grazing and pasture improvement (DCCEEW, 2022). There is a higher probability of encountering the species in grasslands with a high structural complexity. Managed grazing regimes, which avoid high intensity grazing, are important to promote the formation of complex grass structures (Howland *et al.*, 2016). The minimum patch size threshold for medium to long-term habitat and population viability is ≥ 0.5 hectares, which supports predominantly tussock-forming grass species (native or non-native) (DSEWPC, 2011).

	The species Conservation Advice (TSSC, 2016a) identifies habitat critical to the survival of the species as sites that:
	• Support:
	  ○ Breeding habitat, generally indicated by the presence of 2 or more adult individuals or juveniles, and includes complex grass structures, surface rocks or invertebrate burrows
	  ○ Foraging habitat, generally indicated by the presence of good floristic diversity, minimal disturbance and connectivity with other nearby habitat
	  ○ Refuge habitat, generally indicated the by the presence of surface rocks, arthropod burrows or suitable cracks in the soil where lizards can escape disturbance such as trampling by livestock or fire
	• Include areas for long-term protection from development, such as sites currently being managed for conservation purposes
	• Have connectivity value and contribute to the evolutionary potential of the species, such as large areas of habitat within undeveloped areas and connected to breeding areas, or habitat areas that have been free from adverse practices such as ploughing, cropping, cultivation, fertiliser use or heavy grazing
	Where uncertainty exists regarding habitat critical to survival (for instance, small, fragmented, highly modified or exotic habitats in urban areas between 0.1 and 10 ha), the critical importance of a site is likely to depend on one or more of the following characteristics:
	• Occurs at the edge of the known and likely modelled distribution
	• Represents a newly discovered range extension
	• Has not been subject to adverse practices (ploughing, cropping, cultivation, fertiliser use, intense farming) in the last 10 years, or,
	• Contains a high density of lizards found through site surveys

POPULATIONS	There are four distinct genetic lineages of SLL: South Australia & Victorian Wimmera; south-western Victoria (including Melbourne and Geelong); eastern Victoria; and a lineage covering the ACT and Monaro Plains in NSW. These lineages have a high level of genetic divergence and should be considered as separate Evolutionarily Significant Units (TSSC, 2016a). The total number of individuals of the species is unknown, but likely to be in excess of 1,000 individuals. Understanding of fine scale population structure is difficult given the cryptic nature of the species, and the fragmented and disturbed nature of the species habitat (DCCEEW, 2022). Individuals have been recorded moving up to 20 m in a day, and 50 m over several weeks (DCCEEW, 2022). Evidence suggests that the species does not disperse over long distances, as populations have been recorded to be genetically differentiated at distances of less than 400 m (TSSC, 2016a). Due to habitat fragmentation, populations are probably small and isolated (DCCEEW, 2022). All populations of SLL are considered important for the species recovery (TSSC, 2016a).

THREATS	The Conservation Advice for the species (TSSC, 2016a) identifies the following threats:
	• Loss, modification, degradation and fragmentation of habitat from:
	  ○ Urban development
	  ○ High intensity grazing by livestock and kangaroos
	  ○ Ploughing and pasture improvement
	  ○ Rock collection or destruction
	• Invasive species, including:
	  ○ The spread of exotic grasses
	  ○ Predation by cats and foxes
	• Inappropriate fire regimes

RELEVANT PLANS AND POLICIES	Conservation Advice *Delma impar* Striped Legless Lizard (TSSC, 2016a) National Recovery Plan for the Striped Legless Lizard (Delma impar) (Smith and Robertson, 1999) Threat abatement plan for competition and land degradation by rabbits (DoEE, 2016a) Threat abatement plan for predation by feral cats (DoE, 2015c)

	Threat abatement plan for predation by the European red fox (DEWHA, 2008e)
SPECIES-SPECIFIC GUIDELINES	Referral guidelines for the striped legless lizard, *Delma impar* (DSEWPC, 2011) Survey guidelines for Australia's threatened reptiles. EPBC Act survey guidelines 6.6 (DSEWPaC, 2011b)
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1649

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *An overview of the habitat mapping for the species within and outside the Growth Areas*
- *An overview of the population mapping for the species*

Please refer to Chapter 13 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

HABITAT MAPPING	**WITHIN THE SURVEYED AREAS OF THE GROWTH AREAS**
	Mapping is based on the results of targeted surveys undertaken by EHP (2021). The following categories of mapped habitat have been used in the assessment: • Confirmed habitat, comprising areas of contiguous habitat where the species was recorded • Suitable habitat, comprising contiguous areas where the species has not been recorded but which support predominantly native grassland with cracking soils and surface rock
	WITH THE UNSURVEYED AREAS OF THE GROWTH AREAS
	A combination of DELWP's SLL HIM (DELWP, 2017d) and DELWP's EVC mapping for EVC 132 (Plains Grassland) (DELWP, 2005) was used to provide an indication of potential habitat extent within the unsurveyed areas of the Growth Areas
	OUTSIDE THE GROWTH AREAS
	Habitat mapping across the broader Strategic Assessment Area and Study Area was based on the SLL HIM prepared by DELWP (DELWP, 2017d)
POPULATION MAPPING	**RECORD SELECTION**
	Species records were compiled from the VBA and surveys undertaken by EHP. The VBA records were filtered to remove records prior to 1990 for the purpose of the impact assessment
	RECORD DOWNLOAD DATE
	VBA records for SLL used in this assessment were downloaded in February 2025.
	POPULATION DEFINITION
	A discrete population has been defined where SLL has been recorded within mapped patches of habitat separated by less that 400 m. This criteria is based on the information in the Conservation Advice (TSSC, 2016a) and understanding of the small home range and limited dispersal ability of the species.

OCCURRENCE IN THE STUDY AREA

This section describes the occurrence of the species in the Study Area. It includes reference to maps of records and habitat which can be viewed as separate files. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

See Map 19-8 for a map of records and habitat across the Study Area and Map 19-9 for a map of records and habitat across the Strategic Assessment Area.

19.3.1 OCCURRENCE WITHIN GROWTH AREAS

SLL WITHIN THE SURVEYED AREAS OF THE GROWTH AREAS

EHP (2021) undertook targeted surveys for SLL within the two Growth Areas between 28 September and 30 November 2020. The surveys were undertaken in accordance with the *EPBC Act Referral Guidelines for the Vulnerable Striped Legless Lizard, Delma impar* (DSEWPC, 2011) with a total of 77 tile grids checked eight times, comprising a total of 616 tile checks in total (EHP, 2021).

Forty-five individuals were recorded within the NGGA under ten different tile grids. Sites where the species was recorded generally represent the most suitable areas of habitat for SLL within the NGGA. These areas supported a high cover of surface rock, cracking soils and tussock-forming grasses providing inter-tussock space. Altogether, 103.7 ha of confirmed habitat and 76.3 ha of suitable habitat has been mapped across the surveyed areas of the NGGA.

For the purposes of this assessment, the individuals recorded within the NGGA are considered to represent four discrete populations as follows:

- In the north-western corner of the NGGA within a consolidated patch of 47.1 ha of confirmed habitat where 11 individuals were recorded. This is the largest confirmed patch of habitat within the NGGA, supporting multiple remnants of native grassland. Adjacent to this is a 76.3 ha area of suitable habitat containing a consolidated patch of native grassland. This suitable habitat is separated from the confirmed habitat by less than 30 m, and so would be considered within dispersal distance for the lizard. This whole area is likely to be considered critical to the survival of the species based on the definition outlined in the Conservation Advice (TSSC, 2016a)
- In the west of the NGGA within a consolidated patch of 31.6 ha of confirmed habitat where 13 individuals were recorded. This is the second largest confirmed patch of habitat. This area is disconnected from other areas of confirmed or suitable habitat within the NGGA by over 1 km and does not support any mapped native grassland. This area is considered to provide a more marginal representation of habitat critical to the survival of the species
- In the centre of the NGGA within an area of 19.1 ha of confirmed habitat where 20 individuals were recorded. Analysis of aerial imagery of this site indicates that the property has since been extensively cropped (see Figure 5). It is considered highly unlikely that the SLL population is extant on this property. This area is disconnected from other areas of confirmed or suitable habitat within the NGGA areas by over 1 km
- In the east of the NGGA within a thin patch of 5.9 ha of confirmed habitat where 1 individual was recorded. This area of confirmed habitat is small, isolated from other patches of confirmed or suitable habitat, has a very high edge to area ratio and a small number of lizards detected. All of these factors are likely to be impacting on the viability of this population and it is less likely that this area would be considered critical to the survival of the species

Figure 5: Aerial imagery of 350 Emmersons Road, where confirmed habitat was mapped by EHP. This image was extracted from Google Earth, and is dated December 2021

The numbers of individuals recorded using the tile survey method do not provide an indication of population size, or even of relative lizard density. The method is designed to determine presence/absence, where the detection of an individual at a site infers that a population is present. As identified in the Conservation Advice (TSSC, 2016a), all populations of SLL are important to the recovery of the species.

SLL was not recorded within the WGGA. EHP (2021) found that the removal of native vegetation, high levels of grazing, pasture improvement and cultivation across the WGGA has contributed to the decline of high quality habitat for the species. They concluded that it is highly unlikely that a population of SLL is present within the WGGA.

SLL WITHIN THE UNSURVEYED AREAS OF THE GROWTH AREAS

There is potential for SLL to occur within the unsurveyed areas of the NGGA.

DELWP's HIM for SLL provides a broad predictor of presence of the species across the landscape (DELWP, 2017d). When combined with DELWP's EVC mapping for EVC 132 (Plains Grassland) (DELWP, 2005), the two datasets identified an equivalent area to the extent confirmed within the surveyed areas of the Growth Areas as Confirmed habitat and Suitable habitat.

Given the types of ecological values within the unsurveyed areas are likely to be broadly consistent with those already confirmed within the surveyed areas of the Growth Areas (EHP, 2021) the use of these combined datasets was considered appropriate to provide an indication of potential habitat extent within the unsurveyed areas for the purposes of the assessment. However, some accounting was made to reflect the more fragmented nature of the small, rural residential landholdings and the higher proportion of land use for dwellings and driveways compared to the broader Growth Areas. The following method was applied:

- It has been assumed that the two unsurveyed blocks of land along the western boundary of the NGGA support an equivalent area of SLL habitat to the surveyed land based on their location adjacent to or within proximity of known habitat and the apparent continuity of land use as broader agricultural land. The combination of DELWP's HIM for SLL and EVC 132 mapping was therefore used to estimate the extent of potential habitat within these two unsurveyed blocks. These two blocks contribute around 6.6 ha of potential habitat. Note that the property along the western boundary towards the north of the NGGA (870 Geelong-Ballan Road) was able to be accessed as part of

more recent surveys for the Grassland Earless Dragon. These recent surveys did not target SLL, but did confirm the presence of potentially suitable habitat attributes for the species (including native grasses, and rock cover) (Biosis, 2024b)

- The remaining areas of unsurveyed land comprise the rural residential blocks, which are expected to support a reduced or more fragmented distribution of potential habitat which reflects the different land use compared with the surveyed areas of the NGGA. For these areas, potential habitat extent was estimated to be around 75 per cent of that observed within the surveyed areas. This area was calculated as 75 per cent of the extent modelled using DELWP's HIM for SLL and EVC 132 mapping across the rural residential blocks. This approach identified a further 40.3 ha of potential habitat

Altogether, this mapping method identified around 47 ha of potential habitat within the unsurveyed areas of the Growth Areas. Of this, 15.1 is predicted to occur within the portion of Heales Road East subject to process based development.

This method is considered to be suitably precautionary for the purposes of the assessment, and is intended to identify an area of potential SLL habitat within the unsurveyed land that over-predicts extent, as supported by over-the-fence observations of the properties as part of recent site visits during the strategic assessment.

19.3.2 OCCURRENCE WITHIN THE BROADER STUDY AREA

Historical records of SLL within the Strategic Assessment Area and broader Study Area are limited. There is one record on the boundary of the Strategic Assessment Area to the east of the NGGA. However, this record is from 1992 within a rural residential area and there is some uncertainty around what is likely to remain of any suitable habitat.

There are 22 additional records of SLL in the Study Area from 1990. These records are located in the north-east of the Study Area, north of Little River. A number of these records are recent and dated between 2019-2023. 18 of these records are located in the Melbourne Strategic Assessment Western Grassland Reserves, and are likely associated with recent survey efforts within the reserves.

The generally limited historical records in the region is likely to reflect a lack of targeted survey effort rather than the absence of the species or available habitat. DELWP's HIM for SLL provides a broad predictor of presence of the species across the landscape (DELWP, 2017d). It provides useful context for the assessment, identifying approximately 7,897.8 ha of habitat within the Strategic Assessment Areas and broader Study Area.

AVOIDANCE OF IMPACTS WITHIN GROWTH AREAS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of development within the Growth Areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 16.

Avoidance within the NGGA was determined through a structured decision making process as part of the strategic assessment to identify the optimal layout of development and conservation land in the Growth Area (see Section 16.3 of Chapter 16). A key input to evaluate the biodiversity outcomes of the preferred NGGA layout was the avoidance and protection of SLL habitat.

The outcome from this process was the avoidance of a total of 81.1 ha of SLL habitat comprising 50.4 ha of confirmed habitat, 26.5 ha of suitable habitat, and 4.1 ha of potential habitat in unsurveyed areas.

This avoidance focused on habitat areas in the north of the NGGA, protecting the largest patch of confirmed habitat and a portion of the area mapped as suitable habitat. Of the 81.1 ha of avoided habitat, most (73.6 ha) will be protected and managed as an offset within the Northern Conservation Area to maintain and enhance the habitat values for SLL. The Northern Conservation Area provides for connectivity between a known population within the NGGA to areas that could potentially support the species to the north and west.

The remaining 3.4 ha of mapped habitat to be avoided is located within the gully avoidance area. This avoidance area is located in the south of the Elcho Road East precinct. It supports a known population of SLL and connects to the Eastern Conservation Area which is being established to protect and enhance an areas of Natural Temperate Grassland.

This avoidance process had to appropriately balance the social, economic and environmental issues relevant to the Growth Areas. Further avoidance of SLL habitat was not achievable or appropriate for the following key reasons:

- There were significant concerns that further avoidance of land would not deliver real conservation outcomes for the species within the following areas of confirmed habitat:
    - In the centre of the NGGA where 20 individuals were recorded. As discussed, analysis of aerial imagery on this site indicates that the property has been extensively cropped (see Figure 5). It is considered highly unlikely that the SLL population is extant on this property, and the property is unlikely to retain habitat value for the species
    - In the west of the WGGA where 13 individuals were recorded. As noted above, this area is disconnected from other areas of confirmed or suitable habitat within the NGGA and does not support any mapped native grassland
- Any avoided areas would need to be managed in order to provide a benefit to the species. The extent of weeds and level of degradation across much of the NGGA meant there was uncertainty around the efficacy of management and restoration work in additional areas due to the level of modification and extent of weeds. Efforts to address these issues would likely be prohibitively expensive and may be ineffective, with advice from a grassland restoration expert noting that some areas were degraded to the point that re-establishment of native grasses may not be feasible within a 10 year timeframe
- From a social and economic perspective, the cost of acquiring additional land for conservation and management and the associated reduction in net developable area would likely make development across the Growth Area unviable

There is also some potential for SLL to occur within the external infrastructure footprints within the Strategic Assessment Area, outside of the Growth Areas. The Commitments and Measures under the Plan require:

- Targeted surveys within areas that may support SLL along these corridors prior to development and
- Demonstrated avoidance of any confirmed areas of SLL habitat, to the full extent possible

DIRECT IMPACTS

This section provides an analysis of any direct impacts. Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat.

19.3.3 LOSS OF KNOWN POPULATIONS AND POTENTIAL HABITAT

Development under the Plan will lead to direct impacts to SLL within the NGGA. Direct impacts will include:

- The loss of two isolated populations of SLL, including:
    - One population in the west of the NGGA where a total of 13 individuals were recorded
    - One population towards the centre of the NGGA where a total of 20 individuals were recorded, noting that it is highly unlikely that this population is extant
- Clearing of 53.2 ha of confirmed habitat and 49.8 ha of suitable habitat within the surveyed areas
- Clearing of an additional 42.9 ha of potential habitat mapped using desktop data for the unsurveyed areas of the NGGA. Of this, 15.1 ha is predicted to occur within the portion of Heales Road East subject to process based development

This level of clearing was unavoidable and will lead to residual adverse impacts that will need to be addressed through an appropriate package of offsets for SLL.

Importantly, the project will avoid habitat for two of the four known populations of SLL in the NGGA. This includes the area of confirmed and suitable habitat within the north of the NGGA which will be protected, managed and enhanced to provide for the long-term persistence of the local population and will aim to support population recovery through improvement of connectivity and colonisation of suitable habitat areas where the species has not yet been recorded.

19.3.4 FRAGMENTATION OF HABITAT

Development within the Growth Areas will reduce the extent of habitat available for SLL. However, it is not expected to contribute to or exacerbate fragmentation of habitat for the species or lead to the isolation of any areas of known habitat. SLL habitat within the NGGA is already bounded by urban growth and more intensive land uses to the south and east. The existing interface of habitat in the avoided area with rural lands to the north will be unchanged.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The Plan has the potential to introduce or exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 17 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 17 in order to understand the conclusions reached in this section.

19.3.5 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice for SLL identifies a range of threats to the species (DAWE, 2021a). The following threats to SLL are potentially relevant to implementation of the Plan and are discussed further below:

- Habitat degradation from rock collection or destruction
- Spread of weeds
- Predation by cats
- Inappropriate fire regimes

The species is most vulnerable to indirect impacts associated with these threats at the following locations:

- Within the Northern Conservation Area that will be established in the NGGA
- In the gully avoidance area
- In areas of potential habitat that might occur adjacent to the Growth Areas or within the immediate vicinity

There are a number of additional threats to the species identified in the Conservation Advice, such as high intensity grazing by livestock and kangaroos, ploughing and pasture development, and predation by foxes. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to change or exacerbate the risk across the Study Area. Refer to Section 17.2 of Chapter 17 for a detailed assessment of potential indirect impacts associated with the implementation of the Plan.

HABITAT DEGRADATION FROM ROCK COLLECTION OR DESTRUCTION

Surface or embedded rocks are an important habitat feature for SLL. The species may shelter beneath rocks when inactive, seek refuge beneath rocks during times of disturbance and lay their egg under rocks. Rock collection or destruction pose a threat to the species by substantially degrading the species' habitat (TSSC, 2016a).

This potential impact is most relevant to the Northern Conservation Area and the gully avoidance area within the NGGA, where an increased human population may lead to an increase in rock collection; for instance, by residents for their gardens.

The Northern Conservation Area will be actively managed and monitored, with interpretive signage erected to help inform residents of the biodiversity values of the site and the importance of embedded rock to SLL. The Conservation Area is currently used for agriculture which involves a significant risk of rock removal or destruction to enable activities such as slashing or ploughing. Converting this area to management for conservation substantially reduces the overall risk to the species in this area from this potential impact.

Similarly, if public access is allowable within the gully avoidance area, signage will be in place to inform people of the SLL values and instruct them not to remove rocks.

SPREAD OF WEEDS

The spread of weeds is a threat to SLL's native habitat. Weeds outcompete natural grasses and degrade habitat by changing the floristic diversity and structural complexity of grasslands.

Although the invasion of weeds is considered to be a current threat to SLL (TSSC, 2016a), the Plan is unlikely to exacerbate this threat. Weed invasion is a significant existing issue in the Growth Areas, as reported by EHP, landholder surveys and more recent site observations. Development activities are unlikely to influence the spread of weeds in a way that notably impacts the species.

It is also noted that standard weed management protocols will be a relevant requirement of development through the existing planning system.

Further, the areas of SLL habitat that are retained and protected in the Northern Conservation Area will be subject to management to improve the condition of the native grassland. A conservation interface will be established between urban development and the Conservation Area to mitigate potential edge effects, including weeds. This measure will be delivered through Commitment 14, which requires a list of actions to be implemented as part of development to mitigate the indirect impacts of development on the Northern Conservation Area.

Refer to Section 17.2.3 of Chapter 17 for a detailed assessment of potential indirect impacts associated with the spread of weeds under the Plan.

PREDATION BY CATS

Cats are suspected of preying upon SLL, as there is substantial evidence of cat predation on other reptiles in Australia. This is particularly a threat in urban areas which adjoin high density lizard populations (TSSC, 2016a).

This potential impact is most relevant to the Northern Conservation Area and the gully avoidance area, where an increase in nearby housing has the potential to increase the prevalence of domestic and feral cats interacting with the SLL population.

However, cats are likely to already be prevalent in the strategic assessment area due to the level of existing development to the east of the NGGA.

Management of the Northern Conservation Area in accordance with a Conservation Management Plan will address any key threats operating on the SLL population. Should cat predation become an increased issue that adversely affects the population, this will be identified through monitoring and suitable cat management arrangements will be put in place. These processes are expected to adequately address the potential indirect impacts associated with any increase in the prevalence of cats on this area.

Where monitoring identifies cat predation as an active threat in the Northern Conservation Area, cat management and abatement measures will also be implemented within the gully avoidance area.

INAPPROPRIATE FIRE REGIMES

Inappropriate fire regimes pose a threat to the species, either through direct mortality, or through high frequency fires reducing vegetation cover and complexity, which in turn reduces prey availability and may increase the risk of predation. Lack of fire may also threaten the species through a reduction in inter-tussock spaces and loss of tussock-forming species such as Kangaroo Grass (TSSC, 2016a).

The Plan is considered unlikely to notably change or contribute to this threat in the Growth Areas or more broadly given the existing level of development in the Greater Geelong region. The planning system has existing standard mitigation measures in place to address the risk of altered fire regimes and increased fire risk from development. This includes a broad requirement to ensure development can implement bushfire protection measures without unacceptable impacts to biodiversity through appropriate planning.

In addition, the conservation interface established between urban development and the Northern Conservation Area, as well as the ongoing management within the Conservation Area itself, will provide for appropriate fire management to protect SLL values.

Refer to Section 17.2.5 of Chapter 17 for a detailed assessment of potential indirect impacts associated with inappropriate fire regimes under the Plan.

OFFSETS TO COMPENSATE FOR RESIDUAL ADVERSE IMPACTS

This section identifies any offsets needed to address residual adverse impacts to listed threatened species

19.3.6 OFFSETS TO ADDRESS POTENTIAL IMPACTS ASSOCIATED WITH DEVELOPMENT WITHIN THE GROWTH AREAS

There will be residual adverse impacts to SLL as a result of habitat clearing within the NGGA. This clearing will lead to the potential loss of two isolated populations of the species.

To compensate for these impacts, the Plan will deliver an offsets package for SLL comprising two key elements:

- Protection and ongoing management of around 73.6 ha of mapped SLL habitat, and 4.1 ha of potential habitat within the Northern Conservation Area. Specifically for SLL, the conservation area:
    - Focuses on the largest habitat area for Striped Legless Lizard in the NGGA
    - Provides the best opportunities for protecting and managing viable areas of biodiversity in the long term due its suitable shape, area, and condition of the vegetation. This includes enhancing SLL habitat
    - Provides opportunities to restore habitat for SLL. In particular, EHP surveys for SLL within 550 Elcho Road in the south of the Conservation Area did not detect the species or map areas of suitable habitat. More recent surveys for Victorian Grassland Earless Dragon on this property confirmed the potential for management and enhancement efforts on this site to restore habitat for SLL

  The NGGA Area will be a success if:
    - The populations of Striped Legless Lizard persists and remain viable over the long term
    - Habitat for Striped Legless Lizard is retained and condition improves over time
- Protection and ongoing management of 253.5 ha of SLL habitat outside of the Growth Areas. These external offsets will provide for the protection of native habitat areas known to support SLL within Victoria. These offsets will be strategically located and will identify, protect and manage higher quality areas of SLL habitat which are important to the long-term maintenance and recovery of the species into the future.

The offset package delivered under the Plan does not account for potential impacts to habitat within the portion of Heales Road East subject to process based development. Surveys will be undertaken to determine the presence of MNES values in these areas prior to development. Important or notable occurrences of SLL will be avoided, protected, and maintained to ensure persistence. Any unavoidable clearing of SLL habitat within this area will be offset in accordance with the EPBC Act Environmental Offsets Policy and associated Offsets Assessment Guide (Commonwealth of Australia, 2012b). Further details on this process are provided in Section 8.6 of Part 2.

The scale of development under the Plan and assessment through a single Part 10 process under the EPBC Act enables a more strategic approach to offsets compared to those that can be delivered through site-by-site, or Part 9 approval processes. While the ecological benefits of offsets are influenced by a range of factors, there are two key strategic components to the offsets that will be delivered under the Plan which are expected to provide for an improved biodiversity outcome for MNES compared with conventional offsets. These are:

- Coordinated offset delivery within the NGGA: Around 23 per cent of the offset target for SLL will be delivered within the Northern Conservation Area. This is a key outcome of the strategic avoidance planning process, and provides in-situ protection and management of a known population of SLL, local to the areas impacted by development under the Plan
- Spatially planned offsets: Offsets will meet at least one of the following strategic landscape criteria:
    - Protection of SLL habitat areas that would be considered large for the species
    - Located within a key biodiversity corridor and improves connectivity across the landscape
    - Connection of the offset site to an existing conservation reserve

As outlined previously, strategic approaches to offsets such as this, can lead to outcomes that are in the order of 20-40 per cent better than non-strategic offsets (Gordon *et al.*, 2011; Gordon and Peterson, 2019).

19.3.7 OFFSETS TO ADDRESS POTENTIAL IMPACTS ASSOCIATED WITH EXTERNAL INFRASTRUCTURE

Any unavoidable clearing of confirmed areas of SLL within the external infrastructure footprints will be offset in accordance with the EPBC Act Environmental Offsets Policy and associated Offsets Assessment Guide (Commonwealth of Australia, 2012b). Given the existing level of development and land use in these areas, and the need to demonstrate avoidance to the full extent possible under the Plan, the potential level of clearing and associated need for offsets is expected to be minimal.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and the Recovery Plan and draws on the impact analysis presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 17.3 of Chapter 17.

19.3.8 IMPLICATIONS FOR LONG-TERM VIABILITY AND SUMMARY OF OUTCOMES

Forty-five individuals of SLL have been recorded within the NGGA. These lizards were recorded within four isolated areas of habitat across the growth area, including one in the north, one in the west, one towards the centre, and one in the east. Each of these areas is thought to support a discrete population of SLL, given the distance between suitable habitat areas and the limited dispersal ability of the species. All four populations are likely to be important to the recovery of the species.

No individual SLLs were recorded within the WGGA, reflecting a lack of suitable habitat in the area.

Planning for the layout of the NGGA involved a detailed avoidance process which specifically sought to retain SLL values, while balancing social and economic considerations. This process led to the retention of a 135.4 ha area in the north of the NGGA, which contains the largest area of confirmed habitat for SLL as well as an adjacent area of suitable habitat that has the grassland characteristics that are likely to support the species, and an additional 26.8 ha with restoration potential. This habitat will be protected, managed and enhanced as part of a Conservation Area to provide for the long-term persistence of the local population. Management will aim to support population recovery by improving connectivity to enable the species to colonise areas of habitat in the Conservation Area where SLL have not yet been recorded.

Development under the Plan will lead to the loss of the remaining two populations and associated habitat that has been recorded in the NGGA. The habitat condition and viability of these areas is more marginal compared with the area to be retained and protected in the north. However, each of these populations are considered important for the purposes of this assessment and their loss will lead to a residual adverse impact on the species.

These residual impacts will be addressed through the following offsets package:

- Protection and ongoing management of 77.7 ha of SLL habitat within the Northern Conservation Area
- Protection and ongoing management of 253.5 ha of SLL habitat outside of the Growth Areas

These offsets will be delivered strategically, with a significant proportion secured early and in advance of impacts to the species' habitat. This package will make an important and positive contribution to the long-term viability of the species and is considered to appropriately compensate for the residual impacts of development.

19.3.9 CONSISTENCY WITH RECOVERY PLAN

In accordance with Section 146K of the EPBC Act, this section considers whether the implementation of the Plan is not inconsistent with the species' Recovery Plan. It considers two questions:

- Does the Plan prevent achievement of the objectives of the Recovery Plan?
- Does the Plan prevent implementation of the Recovery Plan actions?

These questions are discussed below.

DOES THE PLAN PREVENT ACHIEVEMENT OF THE OBJECTIVES OF THE RECOVERY PLAN?

The primary recovery criterion of the Recovery Plan is that viable populations or clusters of populations of *D. impar* are represented and maintained in reserves or appropriately managed sites across the known distribution of the species. This overall criterion is associated with a series of specific objectives (Smith and Robertson, 1999):

1. Establish and maintain national forums for the discussion and organisation of the conservation of *D. impar* across its natural distribution
2. Determine the distribution of potential *D. impar* habitat
3. Determine the current distribution and abundance of *D. impar* in Victoria, New South Wales, the Australian Capital Territory and South Australia
4. Establish a series of reserves and other managed areas such that viable populations are maintained across the known distribution of the species
5. Determine the habitat use and ecological requirements of *D. impar*
6. Identify the nature and extent of the threatening processes affecting *D. impar*
7. Undertake a program of research and monitoring to provide a basis for adaptive management of *D. impar*
8. Increase community awareness and involve the community in aspects of the recovery program
9. Assess the need for salvage and translocation, determine their feasibilities, develop protocols and undertake a trial translocation if appropriate
10. Ensure that captive population(s) are used to support education and research elements of the Recovery Plan

The outcome under the Plan for SLL will not prevent the achievement of any of the objectives of the Recovery Plan.

DOES THE PLAN PREVENT IMPLEMENTATION OF THE RECOVERY PLAN ACTIONS?

The Recovery Plan identifies a set of actions in order to deliver on the objectives. Each action is associated with performance criteria (Smith and Robertson, 1999). The Plan will not prevent the implementation of any of these actions, nor will it prevent the achievement of any of the performance criteria.

19.3.10 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 19-5 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

Table 19-5: Relevant Key Threatening Processes and associated Threat Abatement Plans for the Striped Legless Lizard

Key threatening process	Threat abatement plan
Competition and land degradation by rabbits	There is no relevant TAP
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP
Predation by feral cats	Threat abatement plan for predation by feral cats (DoE, 2015c)
Predation by European red fox	Threat abatement plan for predation by the European red fox (DEWHA, 2008e)

POTENTIAL TO OCCUR WITHIN THE GROWTH AREAS

This following threatened fauna are assessed in this section:

- Blue-winged Parrot. This species has the potential to occur within the Growth Areas. The presence of potential habitat for this species has not been confirmed by site surveys, as the species was listed as threatened in March 2023
- Victorian Grassland Earless Dragon. This species was not recorded in the Growth Areas during targeted surveys (Biosis, 2024b). Detailed habitat assessment and analysis found that there are areas of grassland which support potentially suitable attributes for the species within the NGGA. This is discussed further in Section 19.5.

19.4 BLUE-WINGED PARROT (*NEOPHEMA CHRYSOSTOMA*)

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, populations, and threats. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable
DESCRIPTION	Blue-winged Parrot is a small parrot up to 24 cm in length and less than 50 g in weight. The species has an olive-green head and upper body, which grades to light green on the fore-neck. It has yellow underparts, and a large dark blue patch on the wings (DCCEEW, 2023b).
ECOLOGY	The breeding season occurs during spring and summer. The species is a partial migrant and most Blue-winged Parrots migrate to Tasmania to breed. The majority of the population will migrate back to the mainland leaving part of the population behind in Tasmania. Breeding also occurs on the mainland, in coastal south-eastern South Australia, and in southern Victoria. Overall, the movements of the species are poorly understood (DCCEEW, 2023b). Breeding occurs in monogamous pairs. Nests are created in the hollows of live or dead trees or stumps. Four to six eggs are laid and incubated by females. Nestlings are fed by both parents (DCCEEW, 2023b). Blue-winged Parrots forage for seeds of native and introduced grasses, herbs and shrubs in pairs or small parties near or on the ground (DCCEEW, 2023b).
DISTRIBUTION AND HABITAT	The species occurs across south-eastern Australia and Tasmania. During the breeding season the species occurs in Tasmania, coastal south-eastern South Australia, and in southern Victoria. During the non-breeding season, the species has been recorded in northern Victoria, eastern South Australia, south-western Queensland, and Western NSW. The species may also reach eastern Victoria and south-eastern NSW, especially during the southern migration (DCCEEW, 2023b). Habitat for Blue-winged Parrot includes coastal, sub-coastal, inland areas, and semi-arid zones. The species is often found near wetlands in semi-arid or coastal areas. It appears to favour habitat comprised of grassy woodlands or grasslands. It has also been observed in disturbed or developed environments including paddocks, airfields and golf courses (DCCEEW, 2023b). Habitat used by the species during the breeding season typically comprises woodlands and eucalypt forests. Breeding habitat in Victoria is typically heathy forests and woodlands, or wetter forests following logging or fire. Habitat used in the non-breeding season varies though may include saltmarshes and agricultural land in Tasmania, and rough pasture and saltmarsh on the mainland. The species may travel up to 100 km to feed in semi-arid chenopod shrubland and sparse grassland during winter (DCCEEW, 2023b). The species Conservation Advice identifies habitat critical to the survival of the species to include areas of (DCCEEW, 2023b): • *Foraging and staging habitats found from coastal, sub-coastal and inland areas, right through to semi-arid zones including: grasslands, grassy woodlands and semi-arid chenopod shrubland with native and introduced grasses, herbs and shrubs* • *Wetlands both near the coast and in semi-arid zones used for foraging and staging*

	• *Eucalypt forests and woodlands within the breeding range in Tasmania, coastal southeastern South Australia and southern Victoria* • *Live and dead trees and stumps with suitable hollows within the breeding range* Further, "*any known or likely habitat should be considered as habitat critical to the survival of the species*" and "*areas that are not currently occupied by the species due to recent disturbance (e.g., fire, grazing or human activity), but should become suitable again in the future, should also be considered habitat critical to the survival of the species*" (DCCEEW, 2023b).
POPULATIONS	It is estimated that there are 10,000 mature individuals in the wild. The population is thought to have declined by 30 – 50 per cent in the past three generations. The Victorian and Tasmanian breeding subpopulations are considered to be separate although they may mix (DCCEEW, 2023b).
THREATS	The Conservation Advice for the species has identified the following threats (DCCEEW, 2023b): • Habitat loss, degradation, and fragmentation – caused by clearing for agriculture, livestock grazing, and invasive weeds • Increased likelihood of extreme weather events associated with climate change • Inappropriate fire regimes • Predation by cats • Predation by foxes on the mainland • Predation by introduced sugar gliders in Tasmania • Competition for tree hollows • Psittacine Beak and Feather Disease
RELEVANT PLANS AND POLICIES	Conservation Advice for *Neophema chrysostoma* (Blue-winged Parrot)(DCCEEW, 2023b) Threat abatement plan for predation by feral cats (DoE, 2015c) Threat abatement plan for predation by the European red fox (DEWHA, 2008e)
SPECIES-SPECIFIC GUIDELINES	There are no species specific guidelines for this species.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=726

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. Please refer to Chapter 13 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

POPULATION MAPPING	**RECORD SELECTION**
	Species records were downloaded from the VBA. The VBA records were filtered to remove records prior to 1990 for the purpose of the impact assessment. Species records from the Atlas of Living Australia were also downloaded to help inform the assessment, as the species was only recently listed as threatened.
	RECORD DOWNLOAD DATE
	VBA records for Blue-winged Parrot used in this assessment were downloaded in February 2025.
	METHOD FOR IDENTIFYING POPULATIONS
	The records of Blue-Winged Parrot within the Study Area are considered to be one population.

OCCURRENCE IN THE STUDY AREA

This section describes the occurrence of the species in the Study Area based a qualitative description of VBA records and potentially suitable habitat.

See Map 19-31 for a map of records across the Study Area.

19.4.1 RECORDS AND POTENTIALLY SUITABLE HABITAT IN THE STUDY AREA

The species has not been recorded in the Strategic Assessment Area. There are 304 VBA records of Blue-winged Parrot within the Study Area. VBA Records occur in higher densities near the wetlands and coastal areas associated with the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. Fewer records are also scattered across inland parts of the Study Area, including in rural pastures, residential areas, woodland remnants and roadside vegetation.

Analysis of Atlas of Living Australia (ALA) records indicates that there are 3,621 records (with an associated count of 55,412 individuals) within the Study Area (ALA, 2025). ALA records are concentrated in the wetlands and coastal areas associated with the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. Records are particularly dense at The Spit and the Western Treatment Plant, along with the Lake Connewarre Complex. A number of records are associated with inland areas including the Brisbane Ranges National Park and the You Yangs Regional Park.

The distribution of records across the Study Area reflects the range of habitat types associated with the species. The density of records in wetlands and coastal areas reflects the relative importance of habitat within the Study Area.

Specific habitat mapping or modelling showing the extent of potential habitat for the species across the Study Area has not been developed as part of the Strategic Assessment. Instead:

- The distribution of VBA and ALA records across the Study Area provides an adequate indication of the type and range of habitats used by the species
- The density of records reflects the relative importance of these habitat types, with the more coastal areas preferred habitat with which the birds appear to show greater fidelity

Potentially suitable habitat within the Growth Areas and the Strategic Assessment Areas is likely limited to foraging areas of native and introduced grassland, although the species may utilise more disturbed areas such as rural residential and agricultural land. Although these areas correspond with some aspects of the habitat description in the Conservation Advice, the Strategic Assessment Area is unlikely to provide important habitat for the species given the:

- Absence of records within the Strategic Assessment Area
- Homogeneity of the landscape and broad availability of similar habitat values across the Victorian Volcanic Plains
- Absence of suitable habitat for breeding, roosting or dispersal within the Strategic Assessment Area
- Ecology of the species. It is highly mobile and may travel up to 100 km inland for foraging habitat (DCCEEW, 2023b)
- Species does not have restricted foraging habitat and demonstrates a level of versatility in the types of environments used for foraging

ANALYSIS OF POTENTIAL IMPACTS AND OUTCOMES FOR THE SPECIES

This section provides an overview of the potential direct and indirect impacts of the Plan on the species, and a discussion of the outcomes of the Plan that are relevant to the species.

19.4.2 AVOIDANCE OF POTENTIAL DIRECT IMPACTS TO RECORDS AND SUITABLE HABITAT

There will be no direct impacts to areas associated with known records of Blue-winged Parrot under the Plan. However, there may be direct impacts to areas of potential foraging habitat associated with grasslands in the Growth Areas.

The avoided areas within the NGGA are likely to provide benefits to the species (see Chapter 16). The Northern Conservation Area supports 55.1 ha of native grassland and areas of non-native grassland which may be suitable for the species. These areas will be protected and managed under the Plan.

19.4.3 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice for Blue-winged Parrot identifies a range of threats to the species (DCCEEW, 2023b). Development under the Plan is unlikely to either introduce or substantially exacerbate any of these threats on the species within the region. This conclusion is based on the:

- Broad distribution of records across the Study Area which indicates that the species uses a variety of habitats, is highly mobile and preferentially uses habitats outside the Strategic Assessment Area which are unlikely to be affected by development
- Landscape context of the existing records in the Study Area including a number of records which are surrounded by or within existing urban development and agricultural land, and therefore already exposed to a range of current threats
- Mitigation measures which are a requirement of the existing planning system and will address and minimise the standard indirect impacts associated with urban development

Refer to Section 17.2 of Chapter 17 for a detailed assessment of potential indirect impacts associated with implementation of the Plan more generally.

19.4.4 OFFSETS PROVIDED UNDER THE PLAN

The Plan is unlikely to lead to residual adverse impacts on the Blue-winged Parrot which would require species-specific offsets. However, it is noted that the Plan will deliver a package of offsets which may provide direct benefits for the species. The Blue-winged Parrot is known to use grassy woodland or grassland habitats (DCCEEW, 2023b). Offsets delivered under the Plan will include areas of potential habitat within the range of the Blue-winged Parrot associated with the following:

- 13.9 ha of Natural Temperate Grassland
- 500.7 ha of known habitat for the Golden Sun Moth
- 331.2 ha of known habitat for the Striped Legless Lizard

19.4.5 SUMMARY OF POTENTIAL IMPACTS AND OUTCOMES FOR THE SPECIES

Overall, the Plan is unlikely to lead to residual adverse impacts for Blue-winged Parrot. The impact assessment presented here concludes that:

- Development under the Plan will not directly impact areas which are known to be used by the Blue-Winged Parrot
- Loss of potential foraging habitat within the Growth Areas is unlikely to affect the species given the reduced relative importance of the potential habitat compared with preferred coastal areas, the broad availability of similar habitat values across the landscape and the dispersal capacity of the species
- Potential indirect impacts to the species are unlikely and any residual indirect impacts will be managed by mitigation measures under the Plan
- The Plan may provide benefits to the species through the protection of grassland habitat including:
    - The avoidance of 135.4 ha of native and introduced grassland in the Northern Conservation Area
    - The offsetting of strategic areas of native grassland within the range of the species through other commonwealth offset commitments

19.4.6 CONSISTENCY WITH RECOVERY PLAN

There is no adopted or made Recovery Plan for this species.

19.4.7 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 19-6 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

Table 19-6: Relevant Key Threatening Processes and associated Threat Abatement Plans for the Blue-winged Parrot

Key threatening process	Threat abatement plan
Fire regimes that cause declines in biodiversity	There is no relevant TAP
Land clearance	There is no relevant TAP

Key threatening process	Threat abatement plan
Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP
Predation by feral cats	Threat abatement plan for predation by feral cats (DoE, 2015c)
Predation by the European red fox	Threat abatement plan for predation by the European red fox (DEWHA, 2008e)
Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species	There is no relevant TAP

19.5 VICTORIAN GRASSLAND EARLESS DRAGON (*TYMPANOCRYPTIS PINGUICOLLA*)

Note regarding taxonomic revision of *Tympanocryptis pinguicolla*

The Victorian Grassland Earless Dragon (VGED) was thought to be extinct until its rediscovery in January 2023. In June 2023, VGED was listed as Critically Endangered under the EPBC Act along with three other Grassland Earless Dragon species. The four species were previously considered to be part of a single species, but were split due to a genetic and morphometric revision by Melville et al. (2019). The four species include:

- *Tympanocryptis pinguicolla* (Victorian Grassland Earless Dragon)
- *Tympanocryptis lineata* (Canberra Grassland Earless Dragon)
- *Tympanocryptis mccartneyi* (Bathurst Grassland Earless Dragon)
- *Tympanocryptis osbornei* (Monaro Grassland Earless Dragon)

An updated Conservation Advice was published for VGED in 2023 (DCCEEW, 2023a), and a Draft Recovery Plan for the four species was made available in October 2023 (DCCEEW, 2023c).

This impact assessment relates only to the VGED.

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, populations and threats. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Critically Endangered
DESCRIPTION	VGED is a small lizard approximately 12 cm in length. They are pale grey-brown to red-brown in colour, with well-defined pale stripes along the back. Grassland Earless Dragon species have a hidden outer ear which is covered in scales (DCCEEW, 2023a).
ECOLOGY	The ecology of VGED is not well known (DCCEEW, 2023a). This is due to both the cryptic nature of the species, and its presumed extinction over recent years. Much of the ecology and habitat requirements of VGED is inferred from studies of the better-known Canberra and Monaro Grassland Earless Dragon (GED) species. The diet of VGED is unrecorded, though it is likely to eat grassland invertebrates. Variability in the abundance of prey may be a significant driver of both reproduction success and timing, and occurrence of VGED (DCCEEW, 2023a). VGED has been recorded using invertebrate burrows for shelter. Burrows may also be used for overwintering, protection from predators, egg development, and retreat from very cold or hot temperatures (based on the Canberra and Monaro species) (DCCEEW, 2023a). Canberra GED have shown strong site fidelity to burrows, which increases as winter approaches (DCCEEW, 2023c). VGED may potentially use soil cracks for shelter (DCCEEW, 2023c). Population dynamics are unknown, although may be similar to the Canberra and Monaro GEDs. These species mature in one year, and live for less than two to three years. They can live over five years in captivity (DCCEEW, 2023a). The annual life cycle of GEDs includes a brumation period over winter, during which individuals become inactive and unresponsive inside of their shelters. GEDs are diurnal (active during the day and inactive at night) (DCCEEW, 2023c). GEDs rarely disperse further than 40 m over days or weeks, and usually remain within 1 m of a burrow (DCCEEW, 2023c). Based on genetic analysis, Canberra GEDs have limited to no ability to disperse degraded grasslands, rivers, or roads. This is likely to apply to the VGED (DCCEEW, 2023a). Studies on the Canberra GED indicate that home range size may be under 0.5 ha (DCCEEW, 2023c).
DISTRIBUTION	Historically, VGED was mostly recorded on the Keilor Plains from Melbourne to Geelong (DCCEEW, 2023c). It is unlikely that the species occurred, or still occurs, more broadly in temperate grasslands of Victoria. VGED was formerly common around the Melbourne CBD (prior to development) and the plains near Sunbury. It was also recorded further west in Werribee, and in the south near Newcomb in Geelong (DCCEEW, 2023a).

	The current distribution of VGED is unknown (DCCEEW, 2023a). VGED is currently known from one site west of Melbourne where the species was rediscovered (Zoos Victoria, 2024). The Conservation Advice includes a modelled distribution of the known and likely habitat for VGED which reflects knowledge of its current known and historical distribution (DCCEEW, 2023a).

HABITAT	GEDs occur in native tussock grasslands with little to no trees or shrubs (DCCEEW, 2023c). Most historical records of VGED are from the Victorian volcanic grasslands of the Keilor Plains. Several historic records are from areas with coastal alluvial soils in the Melbourne City area, suggesting that VGED may occur in coastal grasslands that adjoin saline habitats (DCCEEW, 2023a).
	The Draft Recovery Plan (DCCEEW, 2023c) describes habitat for the VGED to consist of all areas that are currently occupied or are either inferred or confirmed to have been occupied in the past based on the:
	• Modelled distribution of the species
	• Actual or potential occurrence of important habitat attributes
	According to the Draft Recovery Plan, important habitat attributes include (DCCEEW, 2023c):
	• Soil type and substrate structure. The Keilor Plains are categorised by heavy clay soils which bake and crack in summer, areas of bare ground, and projecting boulders (DCCEEW, 2023a)
	• The presence (though not dominance) of native grass tussocks. For VGED, the dominant species are likely to be Slender Wallaby-grass (*Rytidosperma penicillatum*), Kangaroo Grass (*Themeda triandra*) and Tussock Poa (*Poa labillardierei*) based on its historical distribution on the Keilor Plains (DCCEEW, 2023c)
	• Invertebrate burrows, either under or alongside loose basalt boulders, or stand-alone burrows not associated with loose surface rock.
	• Invertebrate prey
	The following may also be important habitat attributes (based on the Canberra GED and Monaro GED) (DCCEEW, 2023c):
	• Open and heterogenous grassland structure with bare ground between grass tussocks
	• Low biomass levels
	• Low grass height (5 to 10 cm)
	The condition and land management of grasslands has a strong influence on whether that grassland is potential habitat for VGED, and the value of that habitat. Critically, the Draft Recovery Plan notes that "*the occurrence of a listed GED is incompatible with ploughing, cropping, sowing of exotic pastures, fertilisation, and de-rocking due to their reliance on native grasses, burrows, rocks, soil and invertebrates*" (DCCEEW, 2023c). Further, the Conservation Advice advises that within the ACT and NSW, GEDs almost exclusively occur in grasslands which have few weeds, among other factors such as no historical ploughing, rock removal or fertilisation, managed fire, and a history of continuous low to moderate grazing (DCCEEW, 2023a).
	Habitat important for the recovery of the listed GEDs
	The Draft Recovery Plan provides a definition for habitat important for the recovery of the listed GEDs to be areas which (DCCEEW, 2023c):
	• Contain the following attributes:
	  ○ Treeless grassland
	  ○ Suitable substrate
	  ○ Native tussocks and forbs, or could be restored to support native tussocks and forbs
	  ○ Burrow-forming invertebrates, or could be restored to support burrow-forming invertebrates and / or embedded surface rocks
	  ○ Embedded surface rocks or could be restored to support embedded and loose surface rocks (Monaro GED and Victorian GED only)
	  ○ Native invertebrate prey or could be restored to support native invertebrate prey
	• Are, or have the potential to be, connected to extant populations, OR
	• If isolated, are large enough to maintain a viable population of the species, with or without the addition of restored adjacent areas.

	Areas important for the recovery of the listed GEDs are defined as "essential for increasing the AOO [Area Of Occupancy], and to maintain and improve dispersal capacity". In addition, these areas are described to "build populations and resilience", either through reintroduction or recolonisation (DCCEEW, 2023c). **Habitat with the greatest likelihood of harbouring a remnant population** Similarly, the Conservation Advice for VGED defines habitat with 'the greatest likelihood of harbouring a remnant population within Victorian volcanic and coastal grasslands' to be those which have (DCCEEW, 2023a): • Native vegetation cover with open patches of bare earth and/or naturally short open swards due to low-level disturbance (e.g. managed fire, grazing) • Invertebrate burrows and/or rock cover and/or cracking vertisol soils • Adequate invertebrate prey (see Lee 2018 for discussion) • Minimal weed cover • Not been de-rocked, ploughed or fertilised to improve pasture quality
POPULATIONS	VGED was undetected between 1969 and 2023, despite numerous targeted surveys across its historical distribution (Zoos Victoria, 2024). There have been unconfirmed sightings in 1988 and 1990 at Merri Creek, Craigieburn Grassland Reserve, the Holden Flora Reserve and Little River. Several areas with potential habitat have not been surveyed (DCCEEW, 2023a). The VGED is currently known from the single rediscovery population. There have been 29 individuals detected in this population since rediscovery. The rediscovery population may be the last remnant population of VGED (Zoos Victoria, 2024). The location of this population is confidential (DCCEEW, 2023c). GEDs are cryptic and may remain undetected at known sites for extended periods despite thorough survey efforts (DCCEEW, 2023c). In addition, there has been significant fluctuations in trapping rates for some populations of the Canberra GED (DCCEEW, 2023a). Further, "*areas with important habitat attributes for a listed GED that occur within the modelled distribution of that species may be occupied but the species is not detected, despite significant survey effort*" (DCCEEW, 2023c). There is one population of VGED housed in captivity (DCCEEW, 2023c).

THREATS	The Conservation Advice (DCCEEW, 2023a) and Draft Recovery Plan (DCCEEW, 2023c) identify the following threats:
	• Habitat loss and degradation due to:
	  ○ Urban development
	  ○ Agricultural activities, including sowing of exotic pastures, ploughing, cropping, de-rocking and fertilisation
	  ○ Grassland management (i.e. slashing and spraying with pesticides)
	• Overgrazing of grasslands by native, domestic and introduced animals, or insufficient grazing. It is noted that low to moderate grazing, particularly by sheep, is beneficial for the Canberra and Monaro GEDs (DCCEEW, 2023c).
	• Weed invasion from serrated tussock, Chilean needlegrass and St Johns wort
	• Too frequent, hot, or out of season fires
	• Prolonged drought
	• Climate change effects, including the frequency, duration and intensity of rainfall, heatwaves, storms and drought
	• Predation by cats, foxes, snakes, and birds

RELEVANT PLANS AND POLICIES	Conservation Advice for *Tympanocryptis pinguicolla* (Victorian grassland earless dragon) (DCCEEW, 2023a) National Recovery Plan for the Grassland Earless Dragon *Tympanocryptis pinguicolla* (Robertson and Evans, 2009) DRAFT National Recovery Plan for the Grassland Earless Dragon *Tympanocryptis pinguicolla* (DCCEEW, 2023c)

SPECIES-SPECIFIC GUIDELINES	Survey guidelines for four Grassland Earless Dragons (*Tympanocryptis* spp.) of Southeast Australia (DCCEEW, 2024f)
SPRAT LINK	https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=66727

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *An overview of the habitat mapping for the species within and outside the Growth Areas*
- *An overview of the population mapping for the species*

Please refer to Chapter 13 for further details about the approach to threatened species baseline data, including a description of the different types and sources of data, as well as some discussion on the interpretation and suitability of the data for use in the impact assessment.

HABITAT MAPPING

WITHIN THE SURVEYED AREAS OF THE GROWTH AREAS

The habitat mapping for VGED shows 'areas with potentially suitable attributes' to support the species. This mapping was based on the:

- VGED habitat suitability assessment (Biosis, 2024b)
- Results of the VGED habitat attribute analysis (Biosis & Open Lines, 2024)

Habitat suitability assessment

A habitat suitability assessment was undertaken as part of the Biosis survey program for VGED (Biosis, 2024b). This was designed to align with the advice provided in the Draft Recovery Plan (DCCEEW, 2023c) and Conservation Advice (DCCEEW, 2023a) about habitat attributes for the species. The habitat suitability assessment involved measuring a range of environmental factors relevant to VGED habitat across a series of quadrats in the NWGGA.

VGED habitat attribute analysis

The data collected through the habitat suitability assessment was used to inform the VGED habitat attribute analysis (Biosis & Open Lines, 2024). The purpose of this work was to:

- Understand if there are habitat values within the NWGGA that are potentially relevant to VGED (as defined by the Conservation Advice and Draft Recovery Plan)
- Understand the relative importance of those values within the NWGGA
- Understand areas that may be unsuitable in terms of habitat attributes for VGED
- Inform planning decisions by the City in relation to the NWGGA

The analysis addressed the knowledge gaps around VGED through the use of a model that facilitated a number of scenarios around potential habitat for the species to help interpret the survey results. The two main approaches applied through the model were:

- A relative habitat value analysis which aimed to understand which areas of the NGGA might be more suitable for VGED based on a range of scenarios
- A threshold approach to identify potentially unsuitable areas which may be too disturbed to provide habitat value for VGED

The scenario that was used to inform this impact assessment identified seven patches with potentially suitable attributes for the species. These patches had (Biosis & Open Lines, 2024):

- Less than 50 per cent weed cover, AND
- More than 2 per cent surface rock cover, AND
- More than 5 per cent embedded rock cover

It is important to note that the work does not identify these patches as habitat for VGED. Rather, the analysis identifies areas which are more likely to be potentially suitable for VGED based on the availability of potential habitat attributes for the species.

WITHIN THE UNSURVEYED AREAS OF THE GROWTH AREAS

	There were a number of areas within the NGGA and WGGA that were initially considered to have the potential to support suitable habitat attributes for VGED which could not be accessed for surveys. Based on over-the-fence observations, review of aerial imagery and available vegetation mapping, the following areas have been included in the habitat mapping for VGED and labelled as 'areas assumed to support potentially suitable habitat attributes'. They include: • A number of polygons in the WGGA associated with the Moorabool River corridor, floodplain, and escarpment • The three unsurveyed properties of the Northern Conservation Area in the NGGA
	OUTSIDE THE GROWTH AREAS
	Potential habitat mapping across the broader Strategic Assessment Area and Study Area was based on the VGED habitat distribution model prepared by DEECA (DEECA, 2024)
POPULATION MAPPING	**RECORD SELECTION**
	Historical records of VGED were extracted from the VBA. Recent records of VGED at the rediscovery site are not publicly available
	RECORD DOWNLOAD DATE
	VBA records for VGED used in this assessment were downloaded in December 2024
	POPULATION DEFINITION
	Populations have not been mapped due to the absence of contemporary records in the Study Area

OCCURRENCE IN THE STUDY AREA

This section describes the occurrence of the species in the Study Area. It includes reference to maps of records and habitat which can be viewed as separate files. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

The NWGGA forms part of the known historical distribution of the species and occurs within the modelled distribution of 'known and likely habitat' shown in the VGED Conservation Advice (DCCEEW, 2023a). Parts of the NWGGA support some of the habitat attributes thought to be associated with GEDs.

Recent targeted surveys for VGED were undertaken for this assessment (Biosis, 2024b) following the rediscovery of the species in Victoria but it was not detected. It is not possible to conclude the absence of the species from the NWGGA based on the results of these surveys given the cryptic nature of GEDs and high levels of variation in detection rates. However, a combination of factors suggest that the likelihood of the species currently occupying the NWGGA is low. These include:

- The degraded condition of the majority of the land within the Growth Areas due to historic and ongoing clearing and agricultural practices
- The fact that very few individuals are expected to remain in the wild, as indicated by almost no contemporary or historical records despite large amounts of indirect and direct survey effort

Instead, the potential importance of the NWGGA to the species relates more to opportunities for species recovery, possibly through reintroduction or recolonisation events. This is the focus of the following impact assessment.

The following section describing VGED occurrence in the Study Area draws on the work and analysis described in detail in the VGED habitat suitability assessment (Biosis, 2024b) and the VGED habitat attribute analysis (Biosis & Open Lines, 2024). These reports should be read in conjunction with this impact assessment.

Map 19-10 shows records and potentially suitable areas across the Study Area. See Map 19-11 for a map of potentially suitable areas within the Strategic Assessment Area, and Map 19-12 for areas likely to meet the definition of 'habitat important for the recovery of VGED' (see below in Section 19.5.2).

19.5.1 SPECIES RECORDS

OCCURRENCE WITHIN THE GROWTH AREAS AND THE STRATEGIC ASSESSMENT AREA

There are no recorded observations of VGED within the NWGGA.

Biosis undertook a comprehensive survey program for VGED within the NWGGA in 2024 (Biosis, 2024b). The first step in the survey program involved identifying 'investigation areas' within the NWGGA to focus efforts on locations with potential suitability for VGED. This process included analysis of aerial imagery, and a preliminary habitat assessment on site. Areas excluded from the investigation areas were clearly unsuitable for VGED due to cropping, tree cover, existing development, a high likelihood of inundation (i.e. dams and wetlands) and areas lacking native vegetation and / or affected by dense cover of tall weeds such as canary grasses, pasture grasses and serrated tussock (Biosis, 2024b).

Targeted surveys were undertaken for VGED across 376.4 ha of the NGGA between January and May 2024. This represents just under 60 per cent of the VGED investigation area in the NGGA. Targeted surveys were undertaken on all properties identified as investigation areas where access was permitted. The location of these surveys was focused on the areas of the properties with the highest likelihood of harbouring a remnant population based on a visual assessment of quality and availability of habitat attributes for VGED. Targeted surveys were not undertaken in the WGGA due to access constraints (Biosis, 2024b).

The targeted surveys involved deploying 'arrays' of survey equipment. Each array consisted of 25 tiles, 15 artificial spider burrows and five mini-pitfall traps. A total of 42 arrays were deployed in the NGGA, and a total of 15 checks of the arrays was conducted. Opportunistic searches were also conducted during the array checks, and involved the use of an endoscope to search natural spider burrows and soil cracks. VGED was not recorded during targeted surveys or opportunistic surveys (Biosis, 2024b).

OCCURRENCE WITHIN THE BROADER REGION

There are 12 historical records of VGED in the VBA (see Map 19-10). The closest records to the NWGGA are located in the Little River area, approximately 15 km north-east of the NGGA. There are four records in the Little River area, one of which was recorded in 1967 and represents the last collected specimen of VGED prior to rediscovery. The remaining three records are dated 1990, and relate to the unvalidated sightings noted in the species Conservation Advice (DCCEEW, 2023a).

The remaining VBA records of VGED are located north of the Werribee River, including a number of records in the Melbourne CBD.

The Conservation Advice for VGED identifies additional historical records in areas as far south as Newcomb in Geelong. These records are not listed in the VBA. Additional historical records in the broader region include (Geelong Field Naturalists Club, 1969):

- Newcomb 1968 – where a specimen was obtained in an unknown location near Newcomb. Newcomb is located around 9 km south-east of the WGGA
- North Geelong 1969 – where an individual was found under stones near the Ballarat Railway-line crossing at Thompson Road. This is located around 3 km to the east of the WGGA

19.5.2 AREAS WITH POTENTIAL HABITAT ATTRIBUTES FOR VGED WITHIN THE GROWTH AREAS

DISCUSSION OF POTENTIAL HABITAT VALUES IN AREAS ACCESSED FOR THE VGED SURVEY PROGRAM

Northern Geelong Growth Area

Overall, the habitat attribute analysis found that the general environmental condition and availability of habitat attributes for VGED varies across the NGGA. A large portion of the areas analysed exhibit high weed cover / low native vegetation cover, de-rocking, and land management practices which are likely to be unsuitable for VGED (particularly cropping and ploughing) (Biosis & Open Lines, 2024).

The analysis concluded that there are seven patches which are more likely to be of potential value for VGED. These patches were consistently highlighted under different approaches to the analysis, and amount to 121.4 ha in total. The seven patches with potentially suitable attributes for VGED include (see Map 19-11):

- 135 Staceys Road – this property is located in the north of the NGGA and is 33.5 ha in size. This patch has moderate weed cover (45 per cent), and good rock cover (4.8 per cent surface rock, 13.8 embedded rock). The property connects through to the Northern Conservation Area to the west, and the northern portion of 135 Staceys Road was added to the Northern Conservation Area during an earlier stage of the NWGGA strategic assessment
- 75 Staceys Road – this property is located in the north of the NGGA east of 135 Staceys Road. Only part of the parcel has been identified through the analysis, which is 25.6 ha in size. The remainder of the property has been cropped and disturbed. This patch has moderate weed cover (40 per cent), and good rock cover (2.4 per cent surface rock and 6.8 per cent embedded rock). The northern section of this patch connects to the portion of 135 Staceys Road which was added to the Northern Conservation Area
- 550 Elcho Road – this property is located in the north-west of the NGGA. Only part of this property (18.6 ha) was identified through the VGED habitat attribute analysis. The area has relatively low weed cover (30.8 per cent), and good rock cover (2.8 per cent surface rock and 18.5 embedded rock). While it is noted that a small part of this area has been used as a bike track the overall patch met the relevant criteria. The remainder of the property has been cleared and / or developed. The northern portion of the property was added to the Northern Conservation Area as part of the most recent structured decision making process to determine the optimal layout of the NGGA (see Section 19.5.3 below)
- Parts of 870 Geelong-Ballan Road – this property is located in the north west of the NGGA, immediately west of 550 Elcho Road. There are two patches on this site, of which one has been identified as potentially suitable under the conservative thresholds (the northern patch). This patch is 2.4 ha in size, and has moderate weed cover (40 per cent) and good rock cover (2 per cent surface rock and 15 per cent embedded rock). The second patch on the south of this property is similar in condition, although may have been subject to some de-rocking of surface rock. This patch is 8.1 ha in size, and has moderate weed cover (40 per cent) and good (although slightly less) surface rock cover (1 per cent surface rock and 15 per cent embedded rock). This property connects through to the power easement and undeveloped land outside of the NGGA to the west
- Part of 775 Evans Road – this property is located in the west of the NGGA. Part of this property (the south to south west) has been disturbed and displays minimal habitat values for VGED. The north to north-east patch on this property however has not been disturbed and is in relatively better condition. This patch is 19.4 ha in size, and has moderate weed cover (40 per cent) and good rock cover (2.3 per cent surface rock, and 10 per cent embedded rock). There is potential for this patch to connect through to the power easement and undeveloped land outside of the NGGA to the west
- Part of 675 Evans Road – this property is located in the west of the NGGA. Much of the property has been disturbed and displays minimal habitat values for VGED. A small patch (6.3 ha) on the southern boundary of the property has been less disturbed and is in better condition. This patch has relatively low weed cover (22.5 per cent), and good to moderate rock cover (3 per cent surface rock, and 5.5 per cent embedded rock)
- Part of 435 Elcho Road – this property is located in the centre of the NGGA, and is surrounded by cropped / disturbed properties. The patch is 7.5 ha in size and has moderate weed cover (45 per cent), and good rock cover (5 per cent surface rock and 8 per cent embedded rock)

The habitat attribute analysis concluded that the remaining patches in the NGGA are unlikely to provide suitable habitat attributes for VGED (Biosis & Open Lines, 2024).

Western Geelong Growth Area

One property in the WGGA was accessed for the habitat suitability assessment, although is considered unlikely to provide potential habitat value for VGED due to the level of weed cover and de-rocking on the site (Biosis & Open Lines, 2024).

POTENTIAL HABITAT VALUES IN AREAS NOT ACCESSED DURING THE VGED SURVEY PROGRAM

Approximately 139 ha (or around 21 per cent) of the total VGED investigation area was not accessed for habitat suitability assessment due to access constraints. This includes parcels of land in both the NGGA and the WGGA.

Of the total investigation areas in the NGGA, approximately 129 ha was not able to be accessed. However, the areas not accessed have generally been cropped or disturbed, and are unlikely to retain good habitat values for VGED (Biosis & Open Lines, 2024). The exception to this is a part of the Northern Conservation Area which was not able to be accessed but is assumed to support suitable habitat attributes based on over-the-fence observation and a review of aerial imagery and available vegetation mapping. This area is already proposed to be set aside for conservation under the Strategic Assessment (this represents 81.3 ha of the unassessed land in the NGGA), which mitigates the risks to VGED associated with a lack of survey access (see Map 19-11).

Around 10 ha of the investigation areas in the WGGA were not able to be accessed. These areas are located to the east of the Moorabool River within a floodplain and escarpment area (see Map 19-11) and are assumed to support suitable habitat attributes for VGED based on over-the-fence observation and a review of aerial imagery and available vegetation mapping.

Areas of potential habitat in the broader Strategic Assessment Area and Study Area

There is limited information about potential habitat and survey effort in the broader Strategic Assessment Area and Study Area given the species presumed extinction.

The habitat distribution model for VGED was updated by DEECA in June 2024 following the species rediscovery. This provides a broad indication of the areas of potential habitat for the species. Overall, the HDM predicts approximately 19,752.96 ha of modelled habitat in the Strategic Assessment Area and Study Area (see Map 19-10) (DEECA, 2024).

The new habitat distribution model for VGED is considered to be particularly conservative due to the significant uncertainty regarding the species persistence across its historical distribution. It is noted that DEECA intends to prepare an additional VGED HDM to complement the standard DEECA HDM products (DEECA, 2024).

Habitat important for the recovery of the listed GEDs

As discussed above, the Draft Recovery Plan defines habitat important for the recovery of the listed GEDs. This is based on whether:

- The areas contain habitat attributes for VGED, AND
- Are, or have the potential to be, connected to extant populations, or if isolated, are large enough to maintain a viable population of the species, with or without the addition of restored adjacent areas

The results of the habitat suitability assessment found that most of the investigation areas which were accessed within the Growth Areas support one or more of the attributes listed in the Draft Recovery Plan (Biosis, 2024b). It is noted that the number, condition and quality of these attributes varies significantly across properties. The VGED habitat attribute analysis concluded that there are seven patches which are potentially suitable for VGED based on the level of weed and rock cover.

VGED is currently only known from the rediscovery population which is located some distance away from the Growth Areas, to the west of Melbourne. VGED has not been detected within the Study Area, although the level of targeted survey effort in or surrounding the Growth Areas is unlikely to be sufficient to conclude that the Growth Areas neither supports nor are connected to extant populations.

The Draft Recovery Plan does not provide a specific parameter on the size of habitat required to maintain 'a viable population' (DCCEEW, 2023c). Information in the Conservation Action Plan for VGED notes that for reintroduction purposes, a benchmark of >100 ha of suitable habitat (though preferably >500 ha) should support a minimum of 200 individuals (Zoos Victoria, 2024).

Based on this information, it is assumed for the purposes of this assessment that areas that may meet the definition of habitat important for the recovery of VGED are areas:

- With potentially suitable attributes, which relates to the seven patches identified through the habitat suitability analysis, and
- Are 100 ha or greater, or connected to an area with some native grassland which is greater than 100 ha or greater

Properties which may meet this definition include (see Map 19-12):

- 500 Elcho Road. The patch with potentially suitable attributes for VGED on this property is 18.6 ha in size
- 870 Geelong-Ballan Road. The patch in the north with potentially suitable attributes for VGED on this property is 2.4 ha in size. It is noted that there is an additional patch in the south of this property which did not meet the threshold conditions in the habitat attribute analysis, although has good potential for restoration
- 135 Staceys Road. The patch with potentially suitable attributes for VGED on this property is 33.5 ha in size
- 75 Staceys Road. The patch with potentially suitable attributes for VGED on this property is 25.6 ha in size

All of these properties are located in the north of the NGGA, and are connected to the Northern Conservation Area. The combined contiguous area of these properties is roughly 160 ha.

The remaining three properties with potentially suitable attributes for VGED are less likely to meet the definition for areas important for recovery. These three patches are isolated, fragmented in the context of GED movement and adjoin areas which have been heavily cropped and disturbed. Given the level of fragmentation, these patches do not meet the assumed size threshold of >100 ha. These patches include (see Map 19-12):

- 435 Elcho Road. The patch with potentially suitable attributes for VGED on this property is 7.5 ha in size
- 775 Evans Road. The patch with potentially suitable attributes for VGED on this property is 19.4 ha in size
- 675 Evans Road. The patch with potentially suitable attributes for VGED on this property is 6.3 ha in size

It is noted that there is no detailed, species specific information about the unsurveyed VGED investigation areas. As such, it is difficult to determine whether these areas meet the definition of areas important for recovery. The following conclusions have been made with the available information:

- Unsurveyed VGED investigation areas in the Northern Conservation Area. It is considered plausible that the three unsurveyed properties in the Northern Conservation Area are likely to meet the definition of areas important for recovery. This is because:
  - Most of the area is mapped as known habitat for Striped Legless Lizard. Some of the habitat preferences of Striped Legless Lizard align with habitat attributes for VGED. This includes native grasses, surface rocks and invertebrate burrows (TSSC, 2016a)
  - The unsurveyed area totals 81 ha, though when combined with the contiguous areas with potentially suitable habitat attributes, the overall area is roughly 160 ha
- Unsurveyed VGED investigation areas in the WGGA. The unsurveyed areas in the WGGA are unlikely to meet the definition of areas important for recovery. Although these areas were mapped as Plains Grassland by EHP (2021), they are small in size (a total of 10 ha across the two patches) and substantially fragmented by agricultural land on the surrounding properties

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of development within the Growth Areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 16.

19.5.3 AVOIDANCE IN THE NORTHERN GEELONG GROWTH AREA

Avoidance within the NWGGA was determined through a structured decision making process as part of the strategic assessment to identify the optimal layout of development and conservation land in the Growth Areas (see Chapter 16 of Part 4).

A key input to evaluate the biodiversity outcomes of the preferred NGGA layout was the avoidance and protection of the seven areas supporting potentially suitable habitat attributes for VGED. This process led to the avoidance of several areas where they support potentially suitable habitat attributes for VGED and were considered to be potentially important for the recovery of VGED. These areas include part of 550 Elcho Road and part of 870 Geelong-Ballan Road which are strategically located to be protected and managed as part of the Northern Conservation Area.

The Northern Conservation Area will provide for the avoidance of 125.3 ha of areas supporting potentially suitable habitat attributes for VGED, including:

- 44 ha of land that supports potentially suitable habitat attributes for VGED, which were confirmed through surveys
- 81.3 ha of areas that were not accessed for VGED habitat suitability surveys, but are assumed to support some of the habitat attributes for the species

These areas are considered likely to meet the definition of areas important for the recovery of VGED. Overall, the Northern Conservation Area provides for avoidance of approximately 59 per cent of the total area supporting potentially suitable habitat attributes for VGED (including both surveyed and unsurveyed areas) within the Growth Areas, and 74 per cent of the areas likely to meet the definition of habitat important for recovery of the VGED within the NGGA.

In addition, the 10 ha of unassessed land within and adjacent to the Moorabool river corridor in the WGGA that is assumed to support some of the habitat attributes for VGED will be avoided.

Overall, 135 ha (or 64 per cent) of areas supporting potentially suitable habitat attributes for VGED (including both surveyed and unsurveyed areas) will be avoided across both Growth Areas.

The level of information available to inform a decision around avoidance for VGED is considered to be sufficient. The information that has been generated through site surveys and habitat analysis aims to address the unique circumstances around the recent rediscovery of the species and uncertainties in the available science. It provides a strong dataset for this assessment in the context of historical land-use and poor site condition and rarity of the species in the landscape.

The structured decision making process that led to the avoidance of potentially suitable areas for VGED within the Growth Areas had to appropriately balance the relevant social, economic and environmental issues. The level of avoidance due to the presence of potentially suitable areas for VGED habitat that was achieved through this decision-making process is considered to deliver an acceptable outcome for the species. From a socio-economic perspective, further avoidance was also not likely to be achievable or appropriate. The cost of acquiring additional land for conservation and management and the associated reduction in net developable area would likely make development across the Growth Area unviable.

Overall, the avoidance planning process is considered to appropriately balance environmental, social and economic priorities in the Growth Areas, while providing a strong conservation outcome with the avoidance, management and restoration of a large, connected area of grassland in the NGGA.

DIRECT IMPACTS

This section provides an analysis of any direct impacts. Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat.

19.5.4 IMPACTS TO KNOWN POPULATIONS AND POTENTIAL HABITAT

Development under the Plan will not lead to direct impacts to known populations of VGED. While acknowledging the challenges in drawing conclusions from a single targeted survey event, the likelihood of unrecorded populations of the species occupying the NWGGA and being directly impacted is considered low based on:

- The extent of environmental decline from agricultural development
- The lack of records across the broader landscape despite targeted and indirect survey effort over decades
- There may be only very few individuals of the species remaining in the wild

However, the NWGGA does occur within the modelled distribution of the species and supports some habitat attributes that are potentially suitable for VGED. These factors mean that the NWGGA could have a role in the potential recovery of the species and it is the loss of these areas of potentially suitable habitat that is the focus of the impact assessment.

Development under the Plan will lead to the clearing of around 77.5 ha of areas supporting potentially suitable habitat attributes. This includes:

- 44.2 ha of areas likely to meet the definition of habitat important for the recovery of the listed GEDs. This habitat is located across four properties:
  - 75 Staceys Road, where 25.5 ha of land with potentially suitable habitat attributes will be impacted. Opportunities for further avoidance of this land were significantly constrained by development viability considerations, and particularly the need to provide for a workable net developable area in the Elcho Road East precinct
  - Three properties which have been partially avoided and form part of the Northern Conservation Area. Further avoidance on these properties was not possible due to socio-economic constraints:
    - 550 Elcho Road, where 3.8 ha of land with potentially suitable habitat attributes will be impacted
    - 870 Geelong-ballan Road, where 5.3 ha of land with potentially suitable habitat attributes will be impacted
    - 135 Staceys, where 9.5 ha of land with potentially suitable habitat attributes will be impacted
- 33.3 ha of areas less likely to meet the definition of areas important for recovery. These impacts relate to the patches in the south of the NGGA which are fragmented and surrounded by more intensive land use

Overall, these impacts relate to around:

- 36 per cent of areas supporting potentially suitable habitat attributes for VGED (including both surveyed and unsurveyed areas) across the Growth Areas
- 26 per cent of potential habitat areas likely to meet the definition of habitat important for recovery of the VGED

19.5.5 FRAGMENTATION OF HABITAT

Areas with potentially suitable habitat attributes for VGED outside of the Northern Conservation Area are already bounded by urban growth, agricultural land and more intensive land uses to the south and east.

Landscape connectivity was a key criterion of the avoidance planning process. The delivery of the Northern Conservation Area will maintain landscape connectivity to the north of the NGGA, and the west through the existing power easement.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The Plan has the potential to introduce or exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 17 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 17 in order to understand the conclusions reached in this section.

19.5.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice (DCCEEW, 2023a) and Recovery Plan (DCCEEW, 2023c) for VGED identifies a range of threats to the species. The following threats to VGED are potentially relevant to implementation of the Plan and are discussed further below:

- Weed invasion
- Inappropriate fire regimes
- Predation by cats, snakes and birds
- Habitat degradation from rock collection

The species is most vulnerable to indirect impacts associated with these threats at the following locations:

- Within the Conservation Area that will be established in the NGGA
- In areas of potential habitat that might occur adjacent to the Growth Areas or within the immediate vicinity

There are a number of additional threats to the species identified in the Conservation Advice, such as high intensity grazing, and predation by foxes and birds. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to change or exacerbate the risk across the Study Area. Refer to Section 17.2 of Chapter 17 for a detailed assessment of potential indirect impacts associated with the implementation of the Plan.

WEED INVASION

Grassland areas are highly susceptible to weed invasion. Areas which are degraded, or located in peri-urban or urban areas are particularly susceptible (DCCEEW, 2023a). Serrated tussock, Chilean needlegrass and St John's wort are weeds causing habitat degradation across the range of all listed Grassland Earless Dragons (DCCEEW, 2023c). Weed management techniques including herbicide use and slashing also affect VGED habitat. Slashing in particular may affect the availability of basking and nesting sites by filling inter-tussock gaps (DCCEEW, 2023a).

The Plan is unlikely to exacerbate this threat. Weed invasion is a significant existing issue in the Growth Areas, as reported by EHP, landholder surveys, and the VGED survey program. Development activities are unlikely to influence the spread of weeds in a way that notably impacts the species.

It is also noted that standard weed management protocols will be a relevant requirement of development through the existing planning system.

Further, the areas with potentially suitable VGED attributes that are retained and protected in the Northern Conservation Area will be subject to management to improve the condition of the native grassland. A conservation interface will be established between urban development and the Conservation Area to mitigate potential edge effects, including weeds. This measure will be delivered through Commitment 14, which requires a list of actions to be implemented as part of development to mitigate the indirect impacts of development on the Northern Conservation Area.

Refer to Section 17.2.3 of Chapter 17 for a detailed assessment of potential indirect impacts associated with the spread of weeds under the Plan.

INAPPROPRIATE FIRE REGIMES

Fire is a natural process in the grassland ecosystems inhabited by GEDs, and is an effective tool for biomass and weed management in Victorian volcanic grasslands (DCCEEW, 2023a, 2023c). However, too frequent, hot or out of season fires may have detrimental impacts to grasslands by changing the structure and composition of vegetation, causing direct mortality, or changing the availability of prey (DCCEEW, 2023c).

The Plan is considered unlikely to notably change or contribute to this threat in the Growth Areas or more broadly given the existing level of development in the Greater Geelong region. The planning system has existing standard mitigation measures in place to address the risk of altered fire regimes and increased fire risk from development. This includes a broad requirement to ensure development can implement bushfire protection measures without unacceptable impacts to biodiversity through appropriate planning.

In addition, the conservation interface established between urban development and the Conservation Area, as well as the ongoing management within the Conservation Area itself, will provide for appropriate fire management to protect the biodiversity values of the Conservation Area.

Refer to Section 17.2.5 of Chapter 17 for a detailed assessment of potential indirect impacts associated with inappropriate fire regimes under the Plan.

PREDATION BY CATS, SNAKES, AND BIRDS

Predation by cats, snakes and birds (including raptors, ravens and magpies) is identified as a threat to VGED. The listed GEDs have small population sizes, which increase the risk of impacts from predation (DCCEEW, 2023c). Potential remnant populations of VGED may be affected by this threat, given the proximity of urban areas to potential habitat (DCCEEW, 2023a).

This potential impact is most relevant to the Northern Conservation Area and the gully avoidance area, where an increase in nearby housing has the potential to increase the prevalence of domestic and feral cats entering the Conservation Area.

While cats are already likely to be in the area, it is acknowledged that the intensification of urban development will increase the number of cats in the area and exacerbate the impact of cats on vulnerable biodiversity values in the Northern Conservation Area.

The Plan includes a commitment (Commitment 5) to prepare a Conservation Management Plan for the Northern Conservation Area. One of the measures that will be undertaken in delivering on this commitment is a requirement that the Conservation Management Plan contain an objective to manage the threat of cat predation for VGED. Potential indirect impacts associated with any increase in the prevalence of cats will be adequately managed by this process.

Where monitoring identifies cat predation as an active threat in the Northern Conservation Area, cat management and abatement measures will also be implemented within the gully avoidance area.

HABITAT DEGRADATION FROM ROCK COLLECTION

The occurrence of GEDs is incompatible with intensive agricultural activities including de-rocking, cropping, fertilisation, ploughing, and sowing of exotic pastures (DCCEEW, 2023c). The removal of rocks in grassland ecosystems reduces the availability of critical shelter resources for VGED. It is likely that de-rocking has contributed to decline and caused significant habitat loss for VGED. In addition, the improved rock crushing technology used on the Victorian Volcanic plains may cause significant damage to habitat, and potentially eliminate an undetected remnant population (DCCEEW, 2023a).

While de-rocking for agricultural reasons will not be intensified under the Plan, this potential impact is most relevant to the Northern Conservation Area, where an increased human population may lead to an increase in rock collection; for instance, by residents for their gardens.

This risk will be mitigated through the active management of the Northern Conservation Area, with interpretive signage to help inform residents of the biodiversity values of the site and the importance of embedded rock to grassland fauna species.

OFFSETS TO COMPENSATE FOR RESIDUAL ADVERSE IMPACTS

This section identifies any offsets needed to address residual adverse impacts to listed threatened species.

19.5.7 OFFSETS TO ADDRESS POTENTIAL IMPACTS ASSOCIATED WITH DEVELOPMENT WITHIN THE GROWTH AREAS

Development under the Plan will result in direct impacts to 77.5 ha of areas with potentially suitable attributes for the species. Part of this area (44.2 ha) is considered likely to meet the definition of habitat important for the recovery of the listed GEDs defined in the Draft Recovery Plan. Direct impacts to habitat that may support recovery is considered a residual adverse impact to VGED.

To compensate for these impacts, the Plan will establish the Northern Conservation Area, which includes 125.3 ha of habitat potentially important for the recovery of Victorian Grassland Earless Dragon. This area will provide for the ongoing protection and management of potential habitat values within the historical distribution of VGED.

The establishment of the Northern Conservation Area contributes to strategy 3 in the Draft Recovery Plan for VGED (DCCEEW, 2023c), to "strategically identify and restore habitat". The avoidance planning process has arrived at a strategic avoidance outcome for VGED, considering the size, location, and connectivity of avoided land within the broader Geelong landscape, and will provide restoration outcomes which will improve the habitat values of these areas for grassland fauna species. A more detailed discussion of the avoidance outcome for VGED against strategy 3 is provided in Section 19.5.9 further in this assessment.

Targeted surveys for VGED have not been undertaken in the external infrastructure footprints within the Strategic Assessment Area, outside of the Growth Areas. To address this, the Commitments and Measures under the Plan require targeted surveys for VGED within suitable habitat along these corridors prior to development. The Plan requires the following avoidance measures to be undertaken should the species be detected:

> *Any confirmed population or part of the population must be avoided and will be protected, maintained and managed to ensure the persistence of that population in the long-term; and the recovery team will be notified*

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice, and draws on the impact analysis presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 17.3 of Chapter 17.

19.5.8 IMPLICATIONS FOR THE SPECIES LONG-TERM VIABILITY AND SUMMARY OF OUTCOMES

The recent rediscovery of the species in Victoria after it was presumed extinct puts the assessment of the NWGGA in a unique context.

The NWGGA occurs within the modelled distribution of the VGED. The rediscovery of the species part way through the strategic assessment process highlighted the need for further information to understand the potential value of the area to the species and re-examine the suitability of the avoidance and conservation outcomes in light of this new information.

Extensive direct and indirect surveys for the species across its likely range over decades had failed to previously detect the species. It is possible that very few populations remain in the wild, with urbanisation and intensive agricultural land-use causing high levels of decline in pre-European numbers and occupied distribution. The species is also cryptic and can remain undetected over periods of time.

These factors mean there is limited information available to define the specific habitat requirements, preferences, and extent of occurrence of the Victorian species.

The approach to the VGED assessment presented here, including the data that has been gathered and analysed, aims to address the circumstances around the rediscovery and uncertainties in the available science. In particular, this work aims to respond to, and align with, the information presented in the Conservation Advice (DCCEEW, 2023a), the Draft Recovery Plan (DCCEEW, 2023c), and the Conservation Action Plan (Zoos Victoria, 2024) for VGED.

The assessment has generated a dataset that is considered adequate for informing decision making around avoidance and the importance of potential impacts. The detailed habitat suitability assessment and habitat attribute analysis report found that parts of the NWGGA support potentially suitable habitat attributes for VGED. However, these areas are degraded due to weeds and other forms of agricultural disturbance (Biosis, 2024b; Biosis & Open Lines, 2024). Across the seven patches with potentially suitable attributes, weed cover was moderate (all but one patch is associated with > 30 per cent weed cover) (Biosis & Open Lines, 2024). The degraded condition of these areas, combined with the agricultural landscape of the Growth Areas and lack of contemporary or historical detection, suggests that the NWGGA is unlikely to harbour a remnant population of VGED.

However, the location of the NWGGA within the modelled distribution and presence of some habitat attributes that are potentially suitable for VGED mean that the Growth Areas could have a role in the potential recovery of the species. It is through this recovery lens that the impact assessment has been undertaken.

Implementation of the Plan will lead to the loss of around 77.5 ha of areas supporting potentially suitable habitat attributes for VGED. Of this, 44.2 ha is considered likely to meet the definition of habitat important for the recovery of the listed GEDs.

To compensate for impacts to these potentially important areas, the Plan will protect and manage 125.3 ha of areas supporting potentially suitable habitat attributes for VGED. These areas will be incorporated into the Northern Conservation Area, providing a strong conservation outcome with habitat restoration potential, and will ensure long-term protection and management of an area potentially suitable for VGED reintroduction within the Geelong region.

Overall, this protection and management is expected to lead to an improvement in the status quo (a net positive outcome) for this species within the NWGGA.

19.5.9 CONSISTENCY WITH RECOVERY PLAN

A Draft Recovery Plan was published for the four species of Grassland Earless Dragon in October 2023. Given that this document has not been finalised, this section will evaluate the consistency of the Plan with both the existing Recovery Plan (Robertson and Evans, 2009), and the recent Draft Recovery Plan (DCCEEW, 2023c).

In accordance with Section 146K of the EPBC Act, this section considers whether the implementation of the Plan is not inconsistent with the species' Recovery Plan. It considers two questions:

- Does the Plan prevent achievement of the objectives of the Recovery Plan?
- Does the Plan prevent implementation of the Recovery Plan actions?

DOES THE PLAN PREVENT ACHIEVEMENT OF THE OBJECTIVES OF THE RECOVERY PLAN?

The objectives of the existing Recovery Plan are (Robertson and Evans, 2009):

4. Determine the distribution and abundance of Grassland Earless Dragons in order to define habitats critical to the survival of the species
5. Maintain or increase the abundance/distribution of the species by better understanding those aspects of the biology of the Grassland Earless Dragon that will enable effective management of populations and habitat
6. Identify the nature and extent of the processes that threaten Grassland Earless Dragons and their habitat, and the measures needed to abate these
7. Establish a system of reserves and other areas under appropriate protection and management such that all populations are maintained or increased
8. Monitor populations and habitats of Grassland Earless Dragons and the implementation and effectiveness of management prescriptions to provide a basis for adaptive management and to identify new threats
9. Determine if there is a need for salvage of individuals from doomed sites, determine the feasibility of such measures, and develop and implement a protocol. Determine if there is a need for translocation, determine its feasibility, and develop and implement a protocol

The objectives of the draft Recovery Plan are (DCCEEW, 2023c):

1. Recovery programs and actions for the four listed GEDs continue to be well co-ordinated, communicated and governed
2. The amount, quality, connectivity and extent of habitat for each extant species is increased
3. The persistence or extinction of the Victorian GED and the Bathurst GED is clarified
4. A resilient population, consisting of large and stable subpopulations, of each extant species is secured

Development under the Plan will not prevent the achievement of any of the objectives of the existing Recovery Plan or the draft Recovery Plan.

In addition, the protection and management of the NGGA Conservation Area will support objective 4 of the existing Recovery Plan, by providing long-term conservation of a large area of potentially suitable for VGED within its historic and modelled distribution (DEECA, 2024).

DOES THE PLAN PREVENT IMPLEMENTATION OF THE RECOVERY PLAN ACTIONS?

The existing Recovery Plan and draft Recovery plan identify a set of strategies with specific actions to deliver the objectives. Each action is associated with performance criteria (Robertson and Evans, 2009; DCCEEW, 2023c).

Of particular relevance to the Plan are Actions 2.1 and 2.3 associated with Strategy 2 in the draft Recovery Plan (DCCEEW, 2023c). These actions are:

- Action 2.1: Enact comprehensive pre-development surveys in all areas with potential habitat for a listed GED, including areas supporting recovery. Surveys are to be implemented by species experts. Implement and enforce strict operational – rather than monetary – penalties to incentivise compliance

- Action 2.3: Pause developments that may pose a risk to inadvertently losing the Victorian or Bathurst GED if re-discovered, or to a new site for the Canberra GED. Ensure the recovery team is immediately integrated into discussions and their recommended actions are implemented

Following the rediscovery of VGED, an extensive survey program was developed in consultation with the VGED Recovery Team (including representatives from Commonwealth DCCEEW, DEECA, and Zoos Victoria). Refer to the survey report for details of the survey program (Biosis, 2024b). The survey program was comprehensive and is considered to satisfy the requirements of Action 2.1.

Parts of the VGED investigation area within the Growth Areas were not able to be accessed for the VGED survey program. As discussed above, the areas not accessed have generally been cropped or disturbed, and unlikely to retain good habitat values for VGED (Biosis & Open Lines, 2024). This excludes the part of the NGGA Conservation Area which was not accessed, and will be set aside for conservation under the Strategic Assessment.

In addition, the conservation outcomes of the Plan are considered to contribute to the following actions associated with strategy 3 of the Draft Recovery Plan (DCCEEW, 2023c):

- 3.1: Identify and strategically prioritise areas for habitat restoration across each species' distribution. Focus on increasing connectivity and iteratively expanding the area and extent of occurrence. Integrate with existing grassland mapping and restoration programs where relevant
- 3.2 Fund actions to restore habitat for listed GEDs
- 3.3 Implement grassland restoration actions

The delivery of the NGGA Conservation Area provides for the strategic protection and management of areas with potentially suitable attributes for VGED, and will deliver grassland and fauna habitat restoration.

Overall, the Plan is considered to adequately address the actions in the existing and draft Recovery Plans for VGED (Robertson and Evans, 2009; DCCEEW, 2023c).

19.5.10 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 19-3 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

Table 19-7: Relevant Key Threatening Processes and associated Threat Abatement Plans for the Victorian Grassland Earless Dragon

Key threatening process	Threat abatement plan
Land clearance	There is no relevant threat abatement plan
Novel biota and their impact on biodiversity	There is no relevant threat abatement plan
Predation by feral cats	Threat abatement plan for predation by feral cats (DoE, 2015c)
Predation by the European red fox	Threat abatement plan for predation by the European red fox (DEWHA, 2008e)
Fire regimes that cause declines in biodiversity	There is no relevant threat abatement plan
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants	There is no relevant threat abatement plan

OCCUR OUTSIDE THE GROWTH AREAS

19.6 COMBINED SPECIES ASSESSMENT

19.6.1 INTRODUCTION

This section contains a combined impact assessment for sixteen bird species and three fish species.

The sixteen bird species:

- Occur in similar locations, generally use similar habitats in the Study Area, and generally have similar ecological traits with regards to habitat use and threatening processes
- Will not be subject to direct impacts:
  - All species have no records within the Growth Areas or the Strategic Assessment Area
  - All species have no mapped habitat in the Growth Areas, and minimal mapped habitat in the wider Strategic Assessment Area
- Will only have potential for indirect impacts under the Plan. Due to ecological similarities between the species, there is substantial overlap in potential impact pathways for each species

The three fish species:

- Use similar habitats in the Study Area and subsequently:
  - Have similar ecological traits with regards to habitat use and threatening processes
  - Occur in similar locations within the Study Area
- Have potential indirect impacts under the Plan. Due to ecological similarities between the species, there is substantial overlap in potential impact pathways for each species

This section is designed to improve clarity and reduce repetition in presenting the assessment results for each of these species. It includes:

- A brief description of where each species occurs within the Study Area
- How the Plan has potential to indirectly impact each species (noting that direct impacts will not occur)
- The mitigation measures under the Plan to mitigate these impacts
- An assessment of whether offsets are required to address residual impacts
- An assessment of approval requirements for migratory species with regards to the Plan
- An overall evaluation of the adequacy of the Plan with regards to these species

It is also recognised that twelve of the sixteen bird species are listed as migratory species under the EPBC Act.

More detailed information on each of the species considered here is located in Attachment A and Attachment B. Information in these Attachments includes:

- Species background, including the species' ecology, distribution, habitat, populations, and threats
- A detailed description of the species' occurrence in the Study Area
- Identification and description of each of the relevant potential indirect impacts to each species due to development under the Plan
- An assessment of consistency of the Plan with the species' Recovery Plan
- Identification of relevant Key Threatening Processes and Threat Abatement Plans for each species

The package of information for each species addresses the requirements of the terms of reference.

19.6.2 HABITAT CONTEXT

This section provides a summary of the locations of the Study Area that are downstream of the Growth Areas. These locations variously provide habitat for the bird and fish species assessed here.

There are four catchments which are hydrologically linked to the Growth Areas (see Map 3-9). These are the Moorabool River catchment, Hovells Creek catchment, Cowies Creek catchment, and the Wharf Road and St Georges drainage system. Refer to Section 3.3.10 of Chapter 3 for a more detailed description of each of these waterways.

The Moorabool River catchment occurs in the south-west of the Strategic Assessment Area. Approximately 39 per cent of the WGGA, and a small proportion of the NGGA (~2 per cent), drains into the Moorabool River (The City of Greater Geelong, 2016). The Moorabool River then flows southward, joining the Barwon River at Fyansford. The Barwon River then continues to flow south into the Lake Connewarre Complex which is part of the Port Phillip Bay and Bellarine Peninsula Ramsar site. This is a large wetland complex which includes multiple wetlands, including Lake Connewarre, Reedy Lake, Hospital Swamp, and Murtnaghurt Lagoon. The wetland is an estuarine system which supports a diverse range of aquatic vegetation communities and provides important feeding and breeding grounds for a wide range of native fish, wetland birds, migratory birds, and threatened species (Corangamite CMA, 2014). The Lake Connewarre Complex then drains southwards into the ocean at Barwon Heads.

The Hovells Creek catchment occurs in the north-east of the Strategic Assessment Area. Approximately 52 per cent of the NGGA will drain to the Hovells Creek Catchment (The City of Greater Geelong, 2016). Downstream of the NGGA, Hovells Creek flows southward into Limeburners Bay, which then discharges into Corio Bay. Limeburners Bay is part of the Port Phillip Bay and Bellarine Peninsula Ramsar site. It supports a range of aquatic vegetation communities and provides key habitat for birds and amphibians (including migratory and threatened species), in addition to a range of recreational values (Corangamite CMA, 2014).

The Cowies Creek catchment occurs in the central part of the Strategic Assessment Area. Approximately 25 per cent of the NGGA and 61 per cent of the WGGA drains to Cowies Creek (The City of Greater Geelong, 2016). Cowies Creek contains freshwater wetlands that occur in ephemeral online pools and drains eastward into Corio Bay.

The Wharf Road and St Georges drainage system is located in the east of the Strategic Assessment Area. Approximately 21 per cent of the NGGA drains into Corio Bay via this system (The City of Greater Geelong, 2016). Drainage lines in this system are comprised of lined open drains. Subsequently, this system is heavily modified and is not considered to support wetland, estuarine or riparian habitat.

19.6.3 SPECIES ADDRESSED IN THE COMBINED ASSESSMENT

The species considered in this combined assessment, their occurrence in the Study Area, and the relevant indirect impacts are shown in:

- Table 19-8 for birds
- Table 19-9 for fish

Indirect impacts were identified as being relevant to the species if:

- The indirect impact is identified as a threat in a relevant profile, Conservation Advice, or Recovery Plan, and
- The Plan has the potential to introduce or exacerbate the threat in areas which support records and/or mapped habitat for the species

Refer to Attachment A and Attachment B for further detail regarding the identification of indirect impacts.

Table 19-8: The occurrence in the Study Area and relevant indirect impacts under the Plan for each of the bird species considered in the combined assessment

Common name	Scientific name	EPBC listing^	Occurrence in the Study Area	Map	Relevant indirect impacts
Australasian Bittern	*Botaurus poiciloptilus*	E	Records and habitat of the Australasian Bittern occur along the shoreline of Port Phillip Bay, from Limeburners Bay through to the Study Area boundary in the north-east. Records and habitat also occur at the Lake Connewarre Complex. A small number of records and habitat occur in the Moolap locality at Point Henry. Smaller areas of mapped habitat occur in riparian environments along the Barwon River, the Moorabool River, Hovells Creek, and Thompson Creek. There are a small number of records at Hovells Creek, and no records in other riparian areas. Isolated records occur in Brisbane Ranges National Park in the north-west of the Study Area, and at the north-east boundary of the Study Area.	Map 19-13	Changes to water flows and quality
Australian Fairy Tern	*Sternula nereis nereis*	V	Mapped habitat and a large number of records for the Australian Fairy Tern occur along the shoreline of Port Phillip Bay, from Limeburners Bay through to the Study Area boundary in the north-east. Multiple records and mapped habitat occur in the Moolap locality. Mapped habitat and a smaller number of records occurs at the Lake Connewarre Complex. A smaller area of habitat not associated with records occurs in the estuarine environment of Thompson Creek in the south of the Study Area.	Map 19-14	Changes to water flows and quality Disturbance from increased public access to natural areas
Australian Painted Snipe	*Rostratula australis*	E	A large area of habitat and some records of the species occur at the Lake Connewarre Complex. Some records occur in the north-east of the Study Area in the locality of Little River. An isolated record occurs at Brisbane Ranges National Park in the north-west of the Study Area. Otherwise, habitat is mapped largely along riparian habitats, including the Moorabool River, Barwon River, Hovells Creek, Little River, and Thompsons Creek. Some habitat is also mapped along the coastline in the Point Wilson area.	Map 19-15	Changes to water flows and quality Disturbance from increased public access to natural areas

Common name	Scientific name	EPBC listing^	Occurrence in the Study Area	Map	Relevant indirect impacts
Black-tailed Godwit	*Limosa limosa*	E; Mig	Mapped habitat and a large number of records for the Black-tailed Godwit occur along the shoreline of Port Phillip Bay, from Limeburners Bay through to the Study Area boundary in the north-east. A number of records and mapped habitat occur in the Lake Connewarre Complex. Scattered records are located in the Moolap area. A smaller area of habitat not associated with records occurs in the estuarine environment of Thompson Creek in the south of the Study Area.	Map 19-16	Changes to water flows and quality Disturbance from increased public access to natural areas
Common Greenshank	*Tringa nebularia*	E; Mig	Mapped habitat and a large number of records for the Common Greenshank occur along the shoreline of Port Phillip Bay, from Limeburners Bay through to the Study Area boundary in the north-east. A large number of records and mapped habitat occur in the Moolap locality, and at the Lake Connewarre Complex. A smaller area of habitat and scattered records occur in the estuarine environment of Thompson Creek in the south of the Study Area.	Map 19-17	Changes to water flows and quality Disturbance from increased public access to natural areas
Curlew Sandpiper	*Calidris ferruginea*	CE; Mig	Mapped habitat and a large number of records for the Curlew Sandpiper occur along the shoreline of Port Phillip Bay, from Limeburners Bay through to the Study Area boundary in the north-east. Multiple records and mapped habitat occur in the Moolap locality, and at the Lake Connewarre Complex. A smaller area of habitat not associated with records occurs in the estuarine environment of Thompson Creek in the south of the Study Area.	Map 19-18	Changes to water flows and quality Disturbance from increased public access to natural areas
Eastern Curlew	*Numenius madagascariensis*	CE; Mig	Mapped habitat and records for the Eastern Curlew occur along the shoreline of Port Phillip Bay, from Limeburners Bay through to the Study Area boundary in the north-east. Records and mapped habitat also occur in the Moolap locality and at the Lake Connewarre Complex. A smaller area of habitat not associated with records occurs in the estuarine environment of Thompson Creek in the south of the Study Area.	Map 19-19	Changes to water flows and quality Disturbance from increased public access to natural areas
Great Knot	*Calidris tenuirostris*	V; Mig	Mapped habitat and records for the Great Knot occur along the shoreline of Port Phillip Bay, from Limeburners Bay through to the Study Area boundary in the north-east.	Map 19-20	Changes to water flows and quality

Common name	Scientific name	EPBC listing^	Occurrence in the Study Area	Map	Relevant indirect impacts
			Records and mapped habitat also occur in the Moolap locality and at the Lake Connewarre Complex. Habitat not associated with records occurs in the estuarine environment of Thompson Creek in the south of the Study Area.		Disturbance from increased public access to natural areas
Greater Sand Plover	*Charadrius leschenaultii*	V; Mig	Two records and mapped habitat for the Greater Sand Plover occurs in the Moolap locality. Otherwise, habitat is mapped along the shoreline of Port Phillip Bay, from Limeburners Bay through to the Study Area boundary in the north-east, and at the Lake Connewarre Complex.	Map 19-21	Changes to water flows and quality Disturbance from increased public access to natural areas
Latham's Snipe	*Gallinago hardwickii*	V; Mig	A large number of records of Latham Snipe occur in the Lake Connewarre Complex and the Moolap Area. A number of records also occur along the shoreline of Port Phillip Bay, between Limeburners Bay and the Study Area boundary in the north-east. There are two records of Latham's Snipe in the Strategic Assessment Area, associated with Cowies Creek downstream of the WGGA. This portion of Cowies Creek is surrounded by the urbanised areas of North Geelong. Latham's Snipe has not been recorded within the Growth Areas. A Habitat Importance Model (HIM) is not available for Latham's Snipe. Roosting habitat includes small wetlands such as saltmarshes, urban water bodies, and creek edges. They may also use pasture and crops. Foraging occurs in shallow water or soft mudflats (DCCEEW, 2024b). Based on the species habitat preferences and the distribution of records, habitat within the Study Area is likely to be associated with wetlands and catchments including the Lake Connewarre Complex, the coastline of Port Phillip Bay, Limeburners Bay, the Barwon River and Moorabool Rivers, and Cowies Creek.	Map 19-22	Changes to water flows and quality Disturbance from increased public access to natural areas
Lesser Sand Plover	*Charadrius mongolus*	E; Mig	Mapped habitat and one record of the Lesser Sand Plover occurs along the shoreline of Port Phillip Bay, from Limeburners Bay through to the Study Area boundary in the north-east. Three records and mapped habitat also occur in the Moolap locality. Mapped habitat not associated with records occurs at the Lake Connewarre Complex and in the estuarine environment of Thompson Creek in the south of the Study Area.	Map 19-23	Changes to water flows and quality Disturbance from increased public access to natural areas

Common name	Scientific name	EPBC listing^	Occurrence in the Study Area	Map	Relevant indirect impacts
Little Tern	*Sternula albifrons*	V; Mig	Mapped habitat and a large number of records of Little Tern occur along the shoreline of Port Phillip Bay, from Limeburners Bay through to the Study Area boundary in the north-east Habitat and several records also occur at Moolap and Lake Connewarre. Additional habitat is mapped along the Barwon and Moorabool rivers.	Map 19-32	Changes to water flows and quality
Orange-bellied Parrot	*Neophema chrysogaster*	CE	Mapped habitat and a large number of records for the Orange-bellied Parrot occur along the shoreline of Port Phillip Bay, from Limeburners Bay through to the Study Area boundary in the north-east. Multiple records and mapped habitat also occur at the Lake Connewarre Complex. Habitat not associated with records is located at Moolap and at the estuarine environment of Thompson Creek in the south of the Study Area.	Map 19-24	Changes to water flows and quality
Red Knot	*Calidris canutus*	V; Mig	Mapped habitat and records for the Red Knot occur along the shoreline of Port Phillip Bay, from Limeburners Bay through to the Study Area boundary in the north-east. Records and mapped habitat also occur in the Moolap locality and at the Lake Connewarre Complex. Habitat not associated with records occurs in the estuarine environment of Thompson Creek in the south of the Study Area.	Map 19-25	Changes to water flows and quality Disturbance from increased public access to natural areas
Sharp-tailed Sandpiper	*Calidris acuminata*	V, Mig	A large number of records of Sharp-tailed Sandpiper occur on the coastline of Port Phillip Bay, between Limeburners Bay and the Study Area boundary in the north-east. Records also occur in the Lake Connewarre Complex, and the Moolap area. A Habitat Importance Model (HIM) is not available for the Sharp-tailed Sandpiper. Sharp-tailed Sandpipers use both saline and freshwater habitats. Foraging occurs on the edge of water in wetlands (coastal and inland), mudflats, and sewage ponds. Roosting habitat includes sandy and rocky beaches, inland saltwater habitats, and freshwater habitats (DCCEEW, 2024a). Based on the species habitat preferences and the distribution of records, habitat within the Study Area is likely to be associated with wetlands and catchments including	Map 19-26	Changes to water flows and quality Disturbance from increased public access to natural areas

Common name	Scientific name	EPBC listing^	Occurrence in the Study Area	Map	Relevant indirect impacts
			the Lake Connewarre Complex, the coastline of Port Phillip Bay and Limeburners Bay.		
Western Alaskan Bar-tailed Godwit	*Limosa lapponica baueri*	E; Mig (as *Limosa lapponica)*	Mapped habitat and records for the Western Alaskan Bar-tailed Godwit occur along the shoreline of Port Phillip Bay, from Limeburners Bay through to the Study Area boundary in the north-east. Records and mapped habitat occur in the Moolap locality, and at the Lake Connewarre Complex. A smaller area of habitat not associated with records occurs in the estuarine environment of Thompson Creek in the south of the Study Area.	Map 19-27	Changes to water flows and quality Disturbance from increased public access to natural areas

^ The following abbreviations have been used: V – Vulnerable; E – Endangered; CE – Critically Endangered; Mig – Migratory

Table 19-9: The occurrence in the Study Area and relevant indirect impacts under the Plan for each of the fish species considered in the combined assessment

Common name	Scientific name	EPBC listing^	Occurrence in the Study Area	Map	Relevant indirect impacts
Australian Grayling	*Prototroctes maraena*	V	Site surveys indicated the presence of suitable habitat at Cowies Creek for the Australian Grayling (EHP, 2021). However, no records of the species occur at Cowies Creek. Potential habitat for the species occurs within the Moorabool River adjacent to the WGGA. Records for this species occur where the Moorabool River meets the Barwon River at Fyansford. Habitat is mapped along the Moorabool River and the Barwon River. Some habitat is also mapped within the Lake Connewarre Complex. Habitat is also mapped at Hovells Creek, although no records occur at this location.	Map 19-28	Changes to water flows and quality Recreational fishing
Little Galaxias	*Galaxiella toourtkoourt*	FPAL	There are no VBA records of the Little Galaxias within the Study Area. However, the species is known to occur within the upper Barwon River catchment near Barwon Downs, and in the Moorabool River near Batesford (EHP, 2021). It is noted that Batesford is within the Study Area and is near the Strategic Assessment Area. It is possible that there are records of the species in this area which have not been entered into the VBA database. The Corangamite CMA is proposing to remove in-stream barriers associated with Batesford quarry within the next few years which may allow the Little Galaxias to access upstream habitat within the Moorabool River (EHP, 2021) Site surveys indicated the presence of suitable habitat at Cowies Creek for the Little Galaxias (EHP, 2021). Potential habitat for the species occurs within the Moorabool River adjacent to the WGGA. Habitat is mapped along the Moorabool River, the Barwon River and at Hovells Creek. Some habitat is also mapped within the Lake Connewarre Complex.	Map 19-29	Changes to water flows and quality Illegal collection
Yarra Pygmy Perch	*Nannoperca obscura*	E	VBA records for this species occur in multiple locations along the Barwon River, within Waurn Ponds Creek, within the Lake Connewarre Complex, and along Thompson Creek. Habitat for the species is mapped along the Moorabool River, Barwon River, Waurn Ponds Creek, Armstrong Creek, and Thompson Creek. Some habitat is also mapped within the Lake Connewarre Complex. Potential habitat for the species occurs within the Moorabool River adjacent to the WGGA.	Map 19-30	Changes to water flows and quality Illegal collection

Common name	Scientific name	EPBC listing^	Occurrence in the Study Area	Map	Relevant indirect impacts
			It is reported that there are records of the species immediately adjacent to WGGA in the Moorabool River (EHP, 2021). However, there are no records in this locality on the VBA database. It is possible that there are records of the species in this area which have not been entered into the VBA database.		

^ The following abbreviations have been used: V – Vulnerable; E – Endangered; CE – Critically Endangered; FPAL – Finalised Priority Assessment List; Mig - Migratory

19.6.4 ANALYSIS OF IMPACTS

This section provides an analysis of the potential impacts for the species. It provides a discussion of avoidance and direct impacts (noting none will occur), and the relevant indirect impacts and how they will be managed under the Plan.

AVOIDANCE AND DIRECT IMPACTS

Bird species

There are no records or potential habitat for any of the bird species within the Growth Areas and the likelihood of the species relying on the Strategic Assessment Area for any key stages of their life cycles is considered to be very low. There will be no direct impacts to any of the species.

Fish species

Potential habitat for the three fish species is mapped within the Moorabool River within the WGGA and the wider Strategic Assessment Area. The Moorabool River corridor within the WGGA will be protected as part of the precinct planning processes for Batesford North, and no direct impacts will occur to habitat for these fish.

INDIRECT IMPACTS

There are two potential indirect impacts associated with development under the Plan which may affect the birds considered in this assessment. These are identified in Table 19-8 and include:

- Changes to water flows and quality
- Disturbance from increased public access to natural areas

Further, there are two potential indirect impacts associated with development under the Plan which may affect the fish considered in this assessment. These are identified in Table 19-9 and include:

- Changes to water flows and quality
- Recreational fishing and illegal collection

Each of these is assessed below. Note that the assessment of changes to water flows and quality considers indirect impacts to both birds and fish.

Changes to water flows and quality

Mechanism of impact

The Plan has the potential to impact on water flows and quality in the following ways (US EPA, 2022):

- Increased impermeable surfaces in developed areas reduces infiltration and increases surface runoff volumes during rain events
- The speed and efficiency of surface runoff flows to streams can be increased by stormwater drainage infrastructure
- Vegetation removal can reduce evapotranspiration

Urbanisation can subsequently increase the frequency, magnitude and duration of high flow events, increase the speed of flow and likelihood of flash flooding, and decrease the lag time of flows (meaning that a flow event finishes more quickly). Stream flow characteristics during low flow periods can also be affected (US EPA, 2022).

Urban development can also impact upon water quality through polluting runoff. Stormwater from urban areas contains a range of pollutants, including sediments, nutrients, organics, and heavy metals and litter (Shahzad *et al.*, 2022).

How impacts can affect threatened birds

Changes to water flows can have a range of impacts on threatened birds. For instance, changes to surface water runoff volumes into estuarine environments can affect water body salinity, affecting habitat values (DAWE, 2020). Increased or decreased discharge volumes can result in habitats either overfilling and becoming inundated or drying up and losing hydrological connections with nearby water bodies (DAWE, 2020). Changed hydrological regimes can also affect the patterns of natural water level fluctuation, which can result in water levels in some areas becoming too deep and developing inappropriate vegetation cover (DSEWPaC, 2013).

Changes to water quality also impacts threatened birds. For example, nutrient enrichment of wetlands can cause cyanobacterium blooms which impact upon habitat values and prey availability (TSSC, 2016c).

How impacts can affect threatened fish

Changes to water flows can have a range of impacts on threatened fish. For example, inappropriate water velocities can impact spawning and migration triggers (TSSC, 2021). Alterations to flooding and drying cycles can also impact habitat connectivity (Saddlier and Hammer, 2010; Saddlier, Jackson and Hammer, 2010).

Changes to water quality can also impact threatened fish. For example, sedimentation can result in siltation of gravel beds, which can affect spawning habitat (TSSC, 2021).

General areas at risk from impacts

The areas which are at risk from impacts to changes in water flows and quality are aquatic environments which are downstream of the Growth Areas. These include the Moorabool River (which flows into the Barwon River and Lake Connewarre Complex), Hovells Creek (which flows into Limeburners Bay), and Cowies Creek.

Areas at risk from impacts associated with bird species

Of these areas, wetland and estuarine environments (including the Lake Connewarre Complex and Limeburners Bay) are most strongly associated with records and habitat for the sixteen bird species assessed here. Riparian environments including the Moorabool River, Barwon River and Hovells Creek are associated with fewer species' records and smaller areas of habitat. There are no records and minimal habitat mapped for the sixteen bird species along Cowies Creek. Refer to Table 19-8 for a brief description of occurrence of each species in the Study Area. Detailed descriptions of occurrence are available in Attachment A.

Areas at risk from impacts associated with fish species

Records of all three fish species occur within the Moorabool catchment. Further, site surveys indicate that suitable habitat is present within the Moorabool River for the Australian Grayling and Little Galaxias (EHP, 2021), while habitat is mapped along the Moorabool River for the Yarra Pygmy Perch. For planning purposes, these species are assumed to be present within the Moorabool River within and adjacent to WGGA and further downstream.

Site surveys have indicated the presence of suitable habitat in Cowies Creek for the Australian Grayling and Little Galaxias (EHP, 2021). Habitat is also mapped in this creek for the Yarra Pygmy Perch. No records of any of these species occur within Cowies Creek.

Potential habitat for all three fish species is mapped within Hovells Creek. No records of the species occur in this creek.

Mitigation measures to minimise impacts

The Plan includes a specific Commitment (Commitment 15) to minimise the indirect impacts of the development on protected matters associated with waterways, riparian areas and wetlands, including EPBC listed threatened and migratory birds, and the three fish species. The measures relevant to water flow and quality that will be undertaken to deliver on this Commitment include:

- Undertaking relevant technical studies to understand the key risks from development on protected matters associated with Hovells Creek, Cowies Creek and the Moorabool River. These studies will:
    - Address potential risks associated with changes to water quality and hydrology as a result of development within the Growth Areas

    - Identify appropriate measures, standards or targets to avoid and minimise adverse impacts on protected matters including, as relevant:
        - Water quality parameters
        - Water retention and flow management requirements
        - Limits on extraction or use
        - Habitat buffer requirements
        - Monitoring and reporting
- Preparing guidelines based on the results of the relevant technical studies to guide the preparation of PSPs and decisions on planning permits and permit conditions to ensure risks to protected matters in relation to indirect and downstream impacts are adequately managed
- Undertaking a planning scheme amendment or other appropriate process to ensure guidelines are considered during preparation of PSPs and in decisions on planning permits and permit conditions

There are also a range of existing measures within the planning system that address changes to water flows and quality. The Geelong Planning Scheme includes requirements to:

- Ensure land use on floodplains minimises the risk of waterway contamination during flooding (Clause 13.03-1S)
- Prevent inappropriate development in areas prone to erosion (Clause 13.04-1S)
- Retain natural drainage corridors, minimise runoff volume from developed areas, filter sediment and waste from stormwater prior to discharge, ensure land use and development minimises nutrient contributions to runoff, and implement measures to minimise sediment discharge from construction sites (Clause 14.02-1S)
- Minimise impacts to water quality through ensuring that land uses which have potential to produce contaminated runoff are appropriately sited and managed (Clause 14.02-2S)
- Implement integrated water management to sustainably manage water supply and demand, water resources, wastewater, drainage, and stormwater (Clause 19.03-3S)

The Geelong Planning Scheme also includes a range of requirements to ensure stormwater management meets appropriate objectives and standards, including objectives for stormwater quality (for example, see Clause 53.18).

The NWGGA Framework Plan also includes various mitigation-related actions to address water flows and quality, including implementation of riparian buffers, and the preparation of masterplans for Cowies Creek and Barwon and Moorabool rivers for integrated water management.

Commitment 13 of the Plan ensures that these standard mitigation measures will continue to be implemented over the life of the Plan. Refer to Section 5.5 of Chapter 5 for a more detailed description of these existing measures.

Implementation of Commitments 13 and 15 under the Plan will adequately minimise the risk of adverse impacts associated with changes to water flow and quality.

Disturbance from increased public access to natural areas

Human disturbance to natural areas can affect threatened migratory birds by interrupting feeding and roosting behaviours, reducing the time available for a species to forage and rest and increasing the time spent by the species engaging in vigilance and anti-predator behaviours. This can affect the species' capacity to build up energy stores required for migration (DoE, 2015b).

Human disturbance to non-migratory threatened birds can also impact breeding success. For example, disturbance can cause adults to leave the nest, which can result in the overheating or chilling of eggs and death of chicks from exposure. Disturbance can also result in adults abandoning nests. Further, predation of eggs and chicks in exposed nests can also increase during periods of human disturbance (DAWE, 2020).

The Plan has potential to increase the risk of disturbance from increased public access to natural areas through increasing the population size of the Geelong region. However, it is also recognised that the Geelong region is already substantially developed, with an existing large population size, in addition to a large number of visitors to the region. Therefore, disturbance of natural areas from public access is considered an existing threat in the region. It is unlikely that the Plan would substantially exacerbate this threat beyond its current levels in the region.

There are a range of existing measures in place in the wider Geelong region to manage human disturbance to natural areas. These include ongoing management of existing reserves and management of domestic dogs in public areas.

There are a number of reserves within the wider Geelong locality which support records and/or habitat for the sixteen threatened birds assessed here. These include Limeburners Lagoon Flora and Fauna Reserve, Lake Connewarre Wildlife Reserve, and The Spit Wildlife Reserve. Each of these reserves is managed by Parks Victoria to protect and enhance flora and fauna values while supporting appropriate community use. Refer to Table 19-10 for further information on the characteristics of each reserve, existing management measures in place, and threatened bird species supported by each reserve (with regards to the sixteen bird species assessed here).

In addition to these reserves, there is also a region at Moolap which is managed for conservation purposes under the Moolap Coastal Strategic Framework Plan. Refer to Table 19-10 for further information.

Further, there are existing management frameworks to manage the impacts of domestic dogs in coastal environments. State-appointed independent land management authorities are responsible for large areas of coastline around the Bellarine Peninsula. These authorities develop dog orders for these coastal areas. Geelong City Council is then responsible for patrolling and enforcing dog orders. Dog orders include seasonal dog orders to protect endangered wildlife and coastal nesting birds (The City of Greater Geelong, 2022c).

Overall, it is considered that the existing management measures in the wider region will adequately minimise the risk of adverse impacts associated with disturbance from increased public access to natural areas.

Recreational fishing and illegal collection

Recreational fishing poses a threat to the Australian Grayling. While it is protected from targeted fishing, the species is still caught incidentally. As a delicate species with deciduous scales, the Australian Grayling is extremely prone to handling stress (TSSC, 2021).

Illegal collection poses a threat to the Little Galaxias and the Yarra Pygmy Perch. Collection has potential to decrease population sizes and impact genetic integrity of wild populations if individuals are released into different populations from where they were collected (Saddlier and Hammer, 2010; Saddlier, Jackson and Hammer, 2010).

The Plan has potential to exacerbate these threats through:

- Increasing the accessibility of the Moorabool River within the WGGA through increasing development in proximity to the river
- Increasing the overall population of the Geelong region, which increases the pressure associated with recreational activities across the landscape.

However, it is recognised that the Geelong region already supports a large population, in addition to large numbers of visitors to the area. In the context of the existing level of threat within the landscape, it is considered unlikely that an increased population density under the Plan would substantially exacerbate these threats.

Table 19-10: Sites within the Geelong region with existing management in place to minimise human disturbance

Site	Site location and description	Existing management	Habitat supported by the reserve	Records (1990 onwards) supported by the reserve
Limeburners Lagoon Flora and Fauna Reserve	This reserve is located within Limeburners Bay and is part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. It is part of a broad, sandy estuarine inlet, with shallow tidal water. The inlet supports shoreline, sandy spit and seagrass environments.	This reserve is managed by Parks Victoria. The following are not permitted: dogs, cats, other pets, horses, bicycles, fires, firearms, and vehicles (excluding management vehicles). (Parks Victoria, 2022c)	Australasian Bittern; Australian Fairy Tern; Australian Painted Snipe; Black-tailed Godwit; Common Greenshank; Curlew Sandpiper; Eastern Curlew; Greater Sand Plover; Lesser Sand Plover; Little Tern; Orange-bellied Parrot; Red Knot; Western Alaskan Bar-tailed Godwit	Australian Fairy Tern; Common Greenshank; Eastern Curlew; Latham's Snipe
Lake Connewarre Wildlife Reserve	This reserve is located within the Lake Connewarre Complex and is part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. It is a large, shallow estuarine lagoon, and contains a diverse range of wetlands and vegetation including mangroves and saltmarsh communities.	This reserve is managed by Parks Victoria. The reserve is large and has variable restrictions in different areas of the reserve. Dogs are permitted on a leash in some locations and are prohibited in other areas. The following are prohibited in some areas, yet permitted in other areas: horses, vehicles (excluding management vehicles), firearms, camping, and generators. Fires are prohibited and boating zones apply throughout the reserve. (Parks Victoria, 2022g, 2022e, 2022d, 2022a)	Australasian Bittern; Australian Fairy Tern; Australian Painted Snipe; Black-tailed Godwit; Common Greenshank; Curlew Sandpiper; Eastern Curlew; Great Knot; Greater Sand Plover; Lesser Sand Plover; Little Tern; Orange-bellied Parrot; Red Knot; Western Alaskan Bar-tailed Godwit	Australasian Bittern; Australian Fairy Tern; Australian Painted Snipe; Black-tailed Godwit; Common Greenshank; Curlew Sandpiper; Eastern Curlew; Great Knot; Latham's Snipe; Little Tern; Orange-bellied Parrot; Red Knot; Sharp-tailed Sandpiper; Western Alaskan Bar-tailed Godwit
The Spit Wildlife Reserve	This reserve is located within the Point Wilson area and is part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. It contains sand spits,	This reserve is managed by Parks Victoria. Public access to this reserve is partially restricted. At publicly accessible sites, dogs and vehicles (excluding management vehicles) are prohibited. Boating zones also apply (Parks Victoria, 2022h, 2022b).	Australasian Bittern; Australian Fairy Tern; Australian Painted Snipe; Black-tailed Godwit; Common Greenshank; Curlew Sandpiper; Eastern	Australasian Bittern; Australian Fairy Tern; Black-tailed Godwit; Common Greenshank; Curlew Sandpiper; Eastern

Site	Site location and description	Existing management	Habitat supported by the reserve	Records (1990 onwards) supported by the reserve
	a lagoon, mudflats and areas of saltmarsh.	Public access to some areas of the reserve is restricted and require a permit from Melbourne Water as the site is adjacent to the Werribee Sewage Farm (Conservation Volunteers Australia, 2022).	Curlew; Great Knot; Greater Sand Plover; Lesser Sand Plover; Little Tern; Orange-bellied Parrot; Red Knot; Western Alaskan Bar-tailed Godwit	Curlew; Great Knot; Latham's Snipe; Lesser Sand Plover; Little Tern; Orange-bellied Parrot; Red Knot; Sharp-tailed Sandpiper; Western Alaskan Bar-tailed Godwit
'Wetlands and Former Saltworks Precinct' within the Moolap Coastal Strategic Framework Plan	The Moolap Coastal Strategic Plan outlines the management objectives and strategies for the Moolap area. The area covered by the Strategic Plan includes the Moolap IBA, in addition to areas of land outside of the IBA. The majority of the Moolap IBA is located in the 'Wetlands and Former Saltworks Precinct' of the Strategic Plan. The area includes salt pans separated by bunds (from a former saltworks) which is used as a feeding location by many migratory birds. Seagrass meadows occur in the shallow bay area adjacent to the salt bunds.	The overarching goal for the Precinct is that the area be managed and coordinated to prioritise environmental outcomes and to respond to existing values and risks. With regards to disturbance management, the Strategic Plan contains a range of strategies, including: • Facilitating while managing public access to enable recreation and passive enjoyment of the area while conserving environmental values • Avoiding and managing risks of domestic animals entering conservation areas • Avoiding boating and marine infrastructure where it would impact ecological values (DELWP, 2019)	Australasian Bittern; Australian Fairy Tern; Australian Painted Snipe; Black-tailed Godwit; Common Greenshank; Curlew Sandpiper; Eastern Curlew; Great Knot; Greater Sand Plover; Lesser Sand Plover; Little Tern; Orange-bellied Parrot; Red Knot; Western Alaskan Bar-tailed Godwit	Australasian Bittern; Australian Fairy Tern; Black-tailed Godwit; Common Greenshank; Curlew Sandpiper; Eastern Curlew; Great Knot; Greater Sand Plover; Latham's Snipe; Lesser Sand Plover; Little Tern; Red Knot; Sharp-tailed Sandpiper; Western Alaskan Bar-tailed Godwit

19.6.5 OFFSETS

Offsets are not required for the sixteen bird species considered here. There are no direct impacts to habitat or records of any of these species under the Plan. Further, indirect impacts will be adequately mitigated through the existing planning system and measures under the Plan.

Offsets are also not required for the three fish species considered here. There are no direct impacts and indirect impacts will be adequately mitigated through the existing planning system and measures under the Plan.

19.6.6 ANALYSIS OF REQUIREMENTS FOR MIGRATORY SPECIES

Twelve of the sixteen bird species considered within this assessment are also listed as migratory species. These are:

- Black-tailed Godwit
- Common Greenshank
- Curlew Sandpiper
- Eastern Curlew
- Great Knot
- Greater Sand Plover
- Latham's Snipe
- Lesser Sand Plover
- Little Tern
- Red Knot
- Sharp-tailed Sandpiper
- Western Alaskan Bar-tailed Godwit (as *Limosa lapponica*)

Section 146L of the EPBC Act sets out the approval considerations in relation to migratory species. In summary, the outcomes of the Plan must not be inconsistent with any of the international agreements relating to migratory species. Of relevance to migratory birds are:

- The Bonn Convention (or the Convention on the Conservation of Migratory Species)
- The bilateral agreements for the conservation of migratory birds between the Government of Australia and the Government of Japan (JAMBA), the Government of China (CAMBA), and the Government of the Republic of Korea (ROKAMBA)

The *Wildlife Conservation Plan For Migratory Shorebirds* (Commonwealth of Australia, 2015) provides a useful summary of Australia's commitments under these agreements. The key obligations (of relevance to this assessment) which cut across the various agreements in different forms are for Australia to:

- Conserve and where possible restore habitats
- Mitigate and manage threats to migratory birds

As outlined in Section 19.6.4 above, the Plan will not result in direct impacts to habitat for any of these migratory species. Further, indirect impacts will be appropriately mitigated through commitments under the Plan, and through existing management measures in the planning system. Overall, the Plan is considered to adequately manage and mitigate threats to migratory birds within the Study Area.

Further, the Plan will not prevent habitats for migratory birds from being conserved and restored.

Overall, the Plan is not inconsistent with international agreements relating to migratory species.

19.6.7 EVALUATION AND CONCLUSION

A review of relevant information, including Conservation Advices, Recovery Plans and other key documents, has been completed for each of the sixteen bird species and three fish species considered here (see Attachment A and Attachment B). This has helped to identify the key issues that have the potential to negatively influence the long-term viability of each of these species. The issues relevant to implementation of the Plan for these species include habitat loss, changes to

water flow and quality, disturbance from increased public access to natural areas, and recreational fishing and illegal collection.

The impact assessment presented here has analysed each of these issues and concluded that:

- There are no direct impacts to any of the bird or fish species under the Plan. Subsequently, habitat loss will not be exacerbated for any of the species due to the Plan
- The potential indirect impacts are unlikely to be exacerbated under the Plan in a way which has a notable effect on any of the species, as:
    - The Plan includes a suitable commitment (Commitment 15) which will minimise the risk of potential indirect impacts associated with changes to water flow and quality. Further, a range of measures already exist within the planning system which will also contribute to minimising this threat
    - There are suitable existing management frameworks in place in natural areas within the Geelong region which will minimise potential impacts associated with increased disturbance from public access to natural areas
- The Plan is not inconsistent with international agreements relating to migratory species

20 Listed threatened flora

This chapter assesses the potential impacts of the Plan on flora species listed as threatened under the EPBC Act.

The categorisation process identified two threatened flora species which may potentially be impacted by implementation of the Plan. This includes one species known to occur within the Growth Areas, *Lachnagrostis adamsonii* (Adamson's Blown-grass), and one species which occurs outside of the Growth Areas, *Pimelea spinescens* subsp. *spinescens* (Spiny Rice-flower). Sections 20.1 and 20.2 assess the potential impacts of the Plan on these species.

Refer to Section 12.3 of Chapter 12 for the method used to identify relevant protected matters.

KNOWN TO OCCUR WITHIN THE GROWTH AREAS

20.1 ADAMSON'S BLOWN-GRASS *(LACHNAGROSTIS ADAMSONII)*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, populations and threats. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Endangered
DESCRIPTION	*Lachnagrostis adamsonii* (Adamson's Blown-grass) is a grass that grows to 70 cm in height. It has open inflorescences that grow up to 25 cm with light green – purple tinged spikelets 3 – 4 mm in length which dry into a pale golden colour (Murphy, 2010).
ECOLOGY	The species flowers from November to December. It produces copious seeds which are dispersed by the wind. Germination occurs during winter and spring. The species appears to have the ability to colonise and expand into surrounding areas if suitable habitat and conditions are present (DCCEEW, 2022). Variation occurs amongst Adamson's Blown-grass populations. This is associated with distribution and site characteristics. The size of plants and number of inflorescences can vary due to seasonal conditions. The species is typically a perennial grass although it may behave as an annual at sites where moisture conditions fluctuate throughout the year (Murphy, 2010).
DISTRIBUTION AND HABITAT	Adamson's Blown-grass is endemic to south-western Victoria, occurring across approximately 15,000 km^2. It is distributed from Clifton Springs near Geelong, to near Coleraine in the Victorian Volcanic Plains and Victorian Midlands IBRA bioregions (Murphy, 2010). The species occurs along slow moving creeks, depressions and drainage lines that are seasonally inundated or waterlogged. Soils comprise black, cracking clays or duplex soils with poorly permeable subsoils. Sites are usually moderately to highly saline and vary in acidity (Murphy, 2010). The species generally won't survive in deeper water although it can tolerate some waterlogging (DCCEEW, 2022). The species appears to favour sites with a level of shelter from the wind which is often provided by other plant species. It is not often found at larger, more exposed saline lakes (Murphy, 2010). Habitat critical to the survival has not been defined. The species' Recovery Plan includes a proposed action to determine its definition (Murphy, 2010).
POPULATIONS	It is highly likely that many historical populations of the species were lost due to extensive native vegetation loss within the Victorian Volcanic Plains and Victorian Midlands (Murphy, 2010). In the 1990s, extensive surveying identified the species at 68 locations. However, the current number of populations is believed to be substantially fewer. The total number of plants is unknown. Estimates suggest there are <50,000 plants. Populations occupy small areas of less than 1 ha (Murphy, 2010). The largest populations of the species occur north-west of Cavendish, south of Glenthompson and Wickliffe, and in the Willaura/Maroona area (DCCEEW, 2022).

	The species 2010 Recovery Plan (Murphy, 2010) identified 16 important populations of the species. One important population occurs within the Strategic Assessment Area located at Warners Road near Cowies Creek. This population consists of up to 500 plants and is considered to be the largest population at the eastern edge of the species range (Murphy, 2010). Site surveys in 2019 and 2020 did not record Adamson's Blown-grass along Cowies Creek. However, the species has been assumed present in Cowies Creek based on the presence of historical records and suitable habitat (this is discussed further below) (EHP, 2021).

THREATS	The species' Recovery Plan has identified the following threats (Murphy, 2010):
	• Altered hydrology, due to:
	  ○ Changes in land use resulting in decreased water availability and soil salinity
	  ○ Climate change resulting in increased droughts
	• Weed invasion / competition
	• Disturbance / destruction of plants and habitat, including through:
	  ○ Disturbance of populations during road and utilities management works
	  ○ Disturbance due to agricultural practices (such as cropping and grazing) on private land
	• Heavy grazing

RELEVANT PLANS AND POLICIES	National Recovery Plan for Adamson's Blown-grass *Lachnagrostis adamsonii* (Murphy, 2010)
SPECIES-SPECIFIC GUIDELINES	There are no species-specific guidelines for this species.
SPRAT LINK	https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=76211

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *An overview of the habitat mapping for the species within and outside the Growth Areas*
- *An overview of the population mapping for the species*

Please refer to Chapter 13 for further details about the approach to threatened species baseline data, including a description of the different types and sources of data, as well as some discussion on the interpretation and suitability of the data for use in the impact assessment.

HABITAT MAPPING	**WITHIN THE SURVEYED AREAS OF THE GROWTH AREAS**
	Habitat for Adamson's Blown-grass within the surveyed areas of the Growth Areas was mapped using the habitat mapping results of the EHP surveys. The species was not recorded during targeted surveys though has been assumed present within suitable habitat along Cowies Creek (EHP, 2021)
	WITHIN THE UNSURVEYED AREAS OF THE GROWTH AREAS
	There is no suitable potential habitat within the unsurveyed areas of the Growth Areas
	OUTSIDE THE GROWTH AREAS
	Adamson's Blown-grass habitat was mapped within wetlands and streams associated with existing VBA records
POPULATION MAPPING	**RECORD SELECTION**
	Species records were compiled from the VBA and surveys undertaken for the project. The VBA records were filtered to remove records prior to 1990 for the purpose of the impact assessment
	RECORD DOWNLOAD DATE
	VBA records for Adamson's Blown-grass used in this assessment were downloaded in February 2025.

	POPULATION DEFINITION
	The historical records of Adamson's Blown-grass within Cowies Creek are considered to be a single population

OCCURRENCE IN THE STUDY AREA

This section describes the occurrence of the species in the Study Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

See Map 20-1 for a map of records and habitat across the Study Area, and Map 20-2 for a map of records and habitat within the Strategic Assessment Area.

20.1.1 OCCURRENCE WITHIN THE GROWTH AREAS AND STRATEGIC ASSESSMENT AREA

There are nine historical VBA records of Adamson's Blown-grass within the Strategic Assessment Area. Two of these records occur within the WGGA adjacent to Cowies Creek within an area that may have been subsequently cropped (EHP, 2021). Both records were recorded in 1995. The remaining records of Adamson's Blown-grass occur less than 100 m from the WGGA and are associated with Cowies Creek. These records represent the important population identified in the species Recovery Plan at Warners Road near Cowies Creek (Murphy, 2010). The most recent of these records was made in 2002 and includes 500 individual Adamson's Blown-grass plants.

Targeted surveys were undertaken for the species within suitable habitat in the Growth Areas between November 2019 and December 2020 by EHP (EHP, 2021).The species was not recorded during these field assessments, which occurred at an appropriate time of year when the species is generally known to be flowering and readily detectable. However, EHP (2021) did not identify any reference population to ensure the species was detectable at the time of survey.

Based on the results of these surveys and a lack of suitable habitat and historical records, the species is unlikely to occur within the NGGA.

EHP made the following observations of potential habitat in the WGGA (EHP, 2021):

> *Potential habitat adjacent to Cowies Creek in the WGGA 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.*

Despite this, Adamson's Blown-grass has been assumed present within Cowies Creek based on historical records and the presence of suitable (albeit marginal) habitat (EHP, 2021).

20.1.2 OCCURRENCE WITHIN THE BROADER STUDY AREA

There is one record of Adamson's Blown-grass in the broader Study Area. The record occurs near Breamlea approximately 19 km south of the Strategic Assessment Area. It is associated with Thompson's Creek and was recorded in 2003.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of development within the Growth Areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 16.

Development under the Plan will avoid impacts to potential habitat for Adamson's Blown-grass associated with Cowies Creek. Potential habitat will be protected within the Cowies Creek Conservation Area.

DIRECT IMPACTS

This section provides an analysis of any direct impacts. Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat.

Implementation of the Plan will not lead to direct impacts or fragmentation of potential habitat for Adamson's Blown-grass.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The Plan has the potential to introduce or exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 17 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 17 in order to understand the conclusions reached in this section.

20.1.3 RELEVANT POTENTIAL INDIRECT IMPACTS

The Recovery Plan for Adamson's Blown-grass identifies a range of threats to the species (Murphy, 2010). The following threats are potentially relevant to implementation of the Plan and are discussed further below:

- Altered hydrological conditions affecting water flows and salinity levels
- Weed invasion

The species is potentially vulnerable to indirect impacts associated with these threats at the following locations:

- Along Cowies Creek in the WGGA where marginal potential habitat has been identified
- Along Cowies Creek upstream of the WGGA where an important population of the species has previously been recorded

There are a number of additional threats to the species identified in the Recovery Plan. However, potential indirect impacts associated with these threats are considered unlikely as a result of development under the Plan. Refer to Section 17.2 of Chapter 17 for a detailed assessment of potential indirect impacts associated with the implementation of the Plan.

Climate change is also identified as a threat to the species. The potential impacts of climate change and relevant mitigation measures under the Plan are outlined in Section 29.5 of Chapter 29.

ALTERED HYDROLOGY

The species has been impacted by changes in water availability in recent years. Altered hydrology impacts Adamson's Blown-grass by changing the salinity of and reducing the level of water in habitat. Adamson's Blown-grass favours saline environments and tends to be out-competed by other species in freshwater environments. Further, periods of drought pose a threat to the species, as populations may not be able to migrate to suitable habitat (Murphy, 2010).

Indirect impacts to Adamson's Blown-grass associated with changes to the hydrological conditions may occur as a result of:

- An increase in hard surfaces due to urban development in the areas of the WGGA and NGGA that are hydrologically linked to Cowies Creek, leading to an increased volume of water entering downstream waterways that might support the species
- Revegetation or restoration works along Cowies Creek within the WGGA which has the potential to alter salinity levels

The Plan includes two key commitments to address the potential indirect impacts of development on hydrology including:

- A commitment (Commitment 15) to minimise the indirect impacts of the development on protected matters associated with waterways, riparian areas and wetlands, including Adamson's Blown-grass. The measures that will be undertaken to deliver on this Commitment include:
    - Undertaking relevant technical studies to understand the key risks from development on protected matters associated with Hovells Creek, Cowies Creek and the Moorabool River. These studies will:
        - Address potential risks associated with changes to water quality and hydrology as a result of development within the Growth Areas
        - Identify appropriate measures, standards or targets to avoid and minimise adverse impacts on protected matters including, as relevant: water quality parameters, water retention and flow management requirements, limits on extraction or use, habitat buffer requirements and monitoring and reporting
    - Preparing guidelines based on the results of the relevant technical studies to guide the preparation of PSPs and decisions on planning permits and permit conditions to ensure risks to protected matters in relation to indirect and downstream impacts are adequately managed
    - Undertaking a planning scheme amendment or other appropriate process to ensure guidelines are considered during preparation of PSPs and in decisions on planning permits and permit conditions
- A commitment (Commitment 10) to prepare and implement a Conservation Management Plan for the protection and ongoing management of the Growling Grass Frog population and areas of potential habitat for Adamson's Blown-grass within the Cowies Creek Conservation Area. One of the measures that will be undertaken to deliver on this Commitment includes a requirement to present the following information in the Conservation Management Plan specifically relating to Adamson's Blown-grass:
    - The location of potential habitat for Adamson's Blown-grass
    - Management actions and arrangements to maintain suitability of the area for Adamson's Blown-grass, including the use of appropriate indigenous species for revegetation

There are also a range of existing measures within the planning system that address changes to water flows. The Geelong Planning Scheme includes requirements to:

- Retain natural drainage corridors, minimise runoff volume from developed areas, filter sediment and waste from stormwater prior to discharge, ensure land use and development minimises nutrient contributions to runoff, and implement measures to minimise sediment discharge from construction sites (Clause 14.02-1S)
- Implement integrated water management to sustainably manage water supply and demand, water resources, wastewater, drainage, and stormwater (Clause 19.03-3S)

The Geelong Planning Scheme also includes a range of requirements to ensure stormwater management meets appropriate objectives and standards, including objectives for stormwater quality (for example, see Clause 53.18).

The NWGGA Framework Plan also includes various mitigation-related actions to address water flows and quality, including implementation of riparian buffers, and the preparation of masterplans for Cowies Creek and the Barwon and Moorabool rivers for integrated water management.

Commitment 13 of the Plan ensures that these standard mitigation measures will continue to be implemented over the life of the Plan. Refer to Section 5.5 of Chapter 5 for a more detailed description of these existing measures.

Implementation of Commitments 10, 13, and 15 under the Plan will adequately minimise the risk of adverse impacts associated with changes to hydrology on Adamson's Blown-grass.

SPREAD OF WEEDS

In areas across its distribution, Adamson's Blown-grass has been found to co-occur with a number of exotic species (Murphy, 2010). Salt-tolerant species pose more of a threat than less salt tolerant species as they may out-compete Adamson's Blown-grass in conditions with increasing salinity. Tall-wheat grass is of particular concern, as it is highly competitive, and invasion of this species is likely to result in the extinction of Adamson's Blown-grass at some sites (Murphy, 2010).

(EHP, 2021) noted the existing degradation of potential habitat areas during their surveys, including the presence of high levels of exotic species. Development activities under the Plan are unlikely to influence the spread of weeds in a way that would noticeably impacts Adamson's Blown-grass along Cowies Creek for the following reasons:

- Potential Adamson's Blown-grass habitat within Cowies Creek will be subject to management to improve the condition of the corridor. This will include the removal of weeds
- A conservation interface will be established between urban development and Cowies Creek to mitigate potential edge effects, including weeds. This will be delivered through Commitment 14, which requires a list of actions to be implemented as part of development to mitigate the indirect impacts of development in the Cowies Creek Conservation Area
- Standard weed management protocols will be a relevant requirement of development through the existing planning system

Refer to Section 17.2.3 of Chapter 17 for a detailed assessment of potential indirect impacts associated with the spread of weeds under the Plan.

OFFSETS TO COMPENSATE FOR RESIDUAL ADVERSE IMPACTS

This section identifies any offsets needed to address residual adverse impacts to listed threatened species

Implementation of the Plan will not lead to direct impacts or fragmentation of the species. As a result, the Plan does not provide specific offsets for the species.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice (if applicable) and the Recovery Plan (if applicable), and draws on the analysis of avoidance, impacts and offsets presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 17.3 of Chapter 17.

20.1.4 IMPLICATIONS FOR THE SPECIES LONG-TERM VIABILITY AND SUMMARY OF OUTCOMES

Adamson's Blown-grass has not been recorded in recent years within the Growth Areas, despite targeted surveys. Marginal potential habitat exists within Cowies Creek in the WGGA, and an important population of the species has previously been recorded nearby the WGGA, upstream along Cowies Creek. This area is towards the edge of the species range, which increases its conservation significance.

Development under the Plan will not impact the species directly. The assessment presented here analysed the potential for the species to be impacted indirectly as a result of potential changes in hydrology and the spread of weeds. It was concluded that the range of commitments and measures under the Plan are expected to adequately protect the species from these potential impacts if it is present.

In this way, development under the Plan is unlikely to adversely influence the long-term viability of Adamson's Blown-grass. The Plan aims to positively contribute to the species in the region by protecting and managing potential habitat within the Cowies Creek Conservation Area where the species has previously been recorded, in order to maintain the suitability of habitat for the long term.

20.1.5 CONSISTENCY WITH RECOVERY PLAN

In accordance with Section 146K of the EPBC Act, this section considers whether the implementation of the Plan is not inconsistent with the species' Recovery Plan. It considers two questions:

- Does the Plan prevent achievement of the objectives of the Recovery Plan?
- Does the Plan prevent implementation of the Recovery Plan actions?

These questions are discussed below.

DOES THE PLAN PREVENT ACHIEVEMENT OF THE OBJECTIVES OF THE RECOVERY PLAN?

The overall objective of the Recovery Plan is to minimise the probability of extinction of *Lachnagrostis adamsonii* in the wild and to increase the probability of populations becoming self-sustaining in the long term. This overall objective is associated with a series of specific objectives (Murphy, 2010):

1. Determine taxonomy, distribution, abundance and population structure
2. Determine habitat requirements
3. Ensure that all populations and their habitat are protected and managed
4. Identify and manage threats to populations
5. Identify key biological functions
6. Determine growth rates and viability of populations
7. Establish a seed bank
8. Build community and government support for conservation

The outcome under the Plan for Adamson's Blown-grass will not prevent of any of the objectives of the Recovery Plan being achieved.

DOES THE PLAN PREVENT IMPLEMENTATION OF THE RECOVERY PLAN ACTIONS?

The Recovery Plan identifies a set of actions in order to deliver on the objectives. Each action is associated with performance criteria (Murphy, 2010). The Plan will not prevent the implementation of any of these actions, nor will it prevent the achievement of any of the performance criteria.

Implementation of the Plan will contribute to achieving the objectives of the Recovery Plan identified above. The protection and management of the Cowies Creek Conservation Area will contribute to Objective 3 of the Recovery Plan by retaining and conserving 4.9 ha of potential Adamson's Blown-grass habitat. Further, commitments and measures under the plan will contribute to Objective 4 through managing threats related to the spread of weeds and potential changes to hydrology.

20.1.6 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 20-1 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

Table 20-1: Relevant Key Threatening Processes and associated Threat Abatement Plans for Adamson's Blown-grass

Key threatening process	Threat abatement plan
Land clearance	There is no relevant TAP
Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP

OCCUR OUTSIDE THE GROWTH AREAS

20.2 SPINY RICE-FLOWER *(PIMELEA SPINESCENS* SUBSP. *SPINESCENS)*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, populations and threats. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Critically Endangered
DESCRIPTION	*Pimelea spinescens* subsp. *spinescens* (Spiny Rice-flower) is a small spreading shrub which grows to approximately 50 cm. The species has narrow green leaves, and pale yellow flowers (TSSC, 2016c).
ECOLOGY	Spiny Rice-flower is slow growing and may live up to 100 years. Generation time is estimated to be between 50 and 80 years (DCCEEW, 2024e). Plants are generally either female or male, and females appear to be more abundant that males. However, hermaphrodites have also been observed (DCCEEW, 2024e). The species flowers between April and August. Germination appears to be stimulated by cooler temperatures in spring and winter, and occurs from May to November. Seedlings remain as non-reproductive recruits for one year, and enter the juvenile stage after the second year. The juvenile stage lasts for approximately five years, after which survival and reproduction is higher. Some juvenile plants may reproduce, though at a much lower rate than mature plants (DCCEEW, 2024e). Spiny Rice-flower is mostly an outcrossing species, and is pollinated by insects including butterflies, honeybees, beetles and flies (DCCEEW, 2024e). Dispersal distances are small. Self-pollination has also been observed (TSSC, 2016c). Seed viability levels are high and stable. There is evidence of a soil seed bank with seeds remaining viable in the soil for approximately 6 years. The majority of populations are comprised of mature individuals which suggests failure of, or an obstacle to recruitment. Higher than average rainfall, and drought conditions appear to inhibit seedling establishment and seed production (DCCEEW, 2024e). The level of fire exposure may have shaped morphological differences between Spiny Rice-flower populations. Individuals in northern areas which have not been exposed to burning are more vigorous and appear to have declined more dramatically than populations in the south which are regularly burnt. This indicates that appropriate fire regimes are important for population persistence and recruitment. Fire also has a role in germination, and seedling establishment. Fire creates bare ground and inter-tussock space, which promotes recruitment from the seedbank and successful seedling establishment. However, if fire occurs prior to or during seed production and flowering, reproduction in that year will not occur. Adult individuals are quite tolerant of fire and can resprout after fire (DCCEEW, 2024e).
DISTRIBUTION AND HABITAT	The Spiny Rice-flower is endemic to Victoria. It occurs predominantly in the Victorian Volcanic Plain, Victorian Midlands and Riverina IBRA Bioregions (TSSC, 2016c; DCCEEW, 2024e). The Growth Areas are towards the south-eastern extent of the species distribution (DCCEEW, 2022). The species habitat comprises intact grassland remnants, grassy woodlands, lowland grasslands and open shrublands. Common ground layers are comprised of Kangaroo Grass (*Themeda triandra*), wallaby grasses (*Rytidosperma* spp.) and spear grasses (*Austrostipa* spp.). The species is mostly found in the following ecological communities, 'Natural Temperate Grassland of the Victorian Volcanic Plain' and 'Natural Grasslands of the Murray Valley Plains'. Populations are observed to occur in varying conditions, including degraded and disturbed patches (DCCEEW, 2024e). Topography is mostly flat, but populations may occur on slight rises or in slight depressions (TSSC, 2016c). Southern populations are associated with heavy grey-black clay loams, while northern populations occur on red clay complexes (TSSC, 2003; DEWHA, 2009a; DCCEEW, 2024e). The Recovery Plan defines habitat critical to the survival of the species to include "*all known habitat for wild and translocated populations*". This includes "*all grasslands, grassy woodlands and open shrub-lands occupied by all known extant populations, areas of similar habitat surrounding and linking known populations, habitat at sites where plants were known to occur until recently, and additional occurrences of*

	similar habitat that may contain undiscovered populations of the species or be suitable for future translocations" (DCCEEW, 2024e).
POPULATIONS	In 2021, the population of Spiny Rice-flower was estimated between 70,000 - 90,000 mature individuals across 275 wild populations. The most recent population survey indicates that there are 325 known populations (DCCEEW, 2024e). Populations mostly occur in small patches of habitat, for example on roadsides or rail easements. Populations are mostly comprised of less than 500 individuals, although there are a few larger populations of over 1,000 individuals. The estimated population size has increased due to the identification of a number of newly discovered sites (DCCEEW, 2024e). Populations are fragmented and isolated, although retain good genetic diversity likely due to the longevity of the species. However, loss of genetic diversity is a risk if older, genetically distinct individuals die out and recruitment levels are low. Smaller populations of 300 to 600 individuals exhibit similar levels of genetic diversity to larger populations comprising greater than 1,000 plants (DCCEEW, 2024e)

THREATS	The species' Conservation Advice (TSSC, 2016b), Recovery Plan (DCCEEW, 2024e) and Significant Impact Guidelines (DEWHA, 2009a) have identified the following threats:
	• Habitat loss and fragmentation due to:
	  ○ Pasture improvement and agricultural intensification
	  ○ Road and rail maintenance
	  ○ Changing land use from farming to industrial and residential land uses
	  ○ Challenges with management on private land and public land not reserved for conservation
	• Inappropriate fire regimes
	• Weed invasion
	• Grazing by feral herbivores and livestock
	• Small and declining populations with limited gene flow
	• Climate change

RELEVANT PLANS AND POLICIES	Conservation Advice *Pimelea spinescens* subsp. *spinescens* Spiny Rice-flower (TSSC, 2016b) National Recovery Plan - Spiny Rice-flower (*Pimelea spinescens ssp spinescens*) (DCCEEW, 2024e) Commonwealth Listing Advice on *Pimelea spinescens* subsp. *spinescens* (Plains Rice-flower, Spiny Rice-flower, Prickly Pimelea) (TSSC, 2003) Threat abatement plan for competition and land degradation by rabbits (DoEE, 2016c)
SPECIES-SPECIFIC GUIDELINES	EPBC Act Policy Statement 3.11 - Significant Impact Guidelines for the Critically Endangered Spiny Rice-flower (*Pimelea spinescens* subsp. *spinescens*) (DEWHA, 2009a)
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=21980

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *An overview of the habitat mapping for the species within and outside the Growth Areas*
- *An overview of the population mapping for the species*

Please refer to Chapter 13 for further details about the approach to threatened species baseline data, including a description of the different types and sources of data, as well as some discussion on the interpretation and suitability of the data for use in the impact assessment.

	WITHIN THE SURVEYED AREAS OF THE GROWTH AREAS
HABITAT MAPPING	There are no areas of habitat mapped within the Growth Areas based on the results of ecological surveys, which concluded that the Growth Areas are unlikely to support habitat for the Spiny Rice-flower (EHP, 2021)

	WITHIN THE UNSURVEYED AREAS OF THE GROWTH AREAS
	There are no areas of habitat mapped within the unsurveyed areas of the Growth Areas based on observations from ecological surveys, which concluded that the unsurveyed areas are likely to support ecological values consistent with those already confirmed within the surveyed areas of the Growth Areas (EHP, 2021)
	OUTSIDE THE GROWTH AREAS
	Habitat mapping across the broader Strategic Assessment Area and Study Area was based on the Spiny Rice-flower HIM prepared by DELWP (DELWP, 2017d)
POPULATION MAPPING	**RECORD SELECTION**
	Species records were downloaded from the VBA. The VBA records were filtered to remove records prior to 1990 for the purpose of the impact assessment
	RECORD DOWNLOAD DATE
	VBA records for Spiny Rice-flower used in this assessment were downloaded in February 2025
	DEFINITIONS OF POPULATIONS
	Population mapping was not undertaken for Spiny Rice-flower records

OCCURRENCE IN THE STUDY AREA

This section describes the occurrence of the species in the Study Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

See Map 20-3 for a map of records and habitat across the Study Area.

20.2.1 SPECIES RECORDS

Targeted surveys were undertaken for Spiny Rice-flower between November 2019 and December 2022. The species was not recorded within the surveyed areas of the Growth Areas and there are no historical records for the species within the Growth Areas.

There is one existing VBA record of Spiny Rice-flower from 2010 in the Strategic Assessment Area, which occurs near Heales Road, approximately 1.3 km east of the NGGA. This appears to be a single plant associated with the Geelong Ring Road Employment Precinct. The property in which the record is located does not appear to have been developed. However, it is in the middle of an industrial area, and it is unknown whether the individual is extant.

There are 646 VBA records of Spiny Rice-flower within the Broader Study Area. The majority of these records occur in three broad areas, including:

- Approximately 12 km west of the Growth Areas near Bannockburn
- Between Lara and the north-eastern boundary of the Study Area, where a number of populations have been recorded along roadsides. The nearest of these populations is approximately 6.3 km from the Growth Areas
- At Lake Borrie Spit, at the Western Treatment Plant, over 18 km east of the NGGA

20.2.2 POTENTIAL HABITAT

Prior to surveys, the species was considered to have the potential to occur within patches of native vegetation and areas supporting embedded rock within the Growth Areas (EHP, 2021). However, systematic targeted searches within the surveyed areas did not detect the species. Site conditions across the two Growth Areas were found to exhibit few of the preferred habitat attributes of the species. EHP noted that 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. They found that most habitats within the WGGA were comprised of improved pasture, combined with agricultural land use, ongoing disturbance (grazing, slashing), high biomass, no recent evidence of fire and little to no inter- tussock space (EHP, 2021).

It is reasonable to assume that the likelihood of suitable habitat occurring within the unsurveyed areas of the Growth Areas is also low, consistent with the types of values observed in the surveyed areas and in the context of more modified or disturbed environments associated with rural residential landholdings.

Altogether, there is a low likelihood that the Growth Areas supports a population of the species.

In the Strategic Assessment Area and Study Area more broadly, the DELWP HIM for Spiny Rice-flower has been used to provide a high-level indication of potential habitat. This approach has mapped 32,136.6 ha of potential habitat for the Spiny Rice-flower across this broader area.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of development within the Growth Areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 16.

Spiny Rice-flower has a low likelihood of occurrence within the Growth Areas. Specific avoidance for the species associated with development within the Growth Areas is therefore not relevant.

Despite this, further surveys will be undertaken in the portion of Heales Road East subject to process based development for all protected matters with the potential to occur. This Plan includes a commitment that any confirmed population or occurrence of MNES that would be considered important or notable within this area is avoided, protected, maintained and managed. Given the listing status of Spiny Rice Flower, if any individuals were recorded in these areas, avoidance would be necessary. Section 8.6 of Part 2 provides further details on process based development in Heales Road East.

There is also some potential for the species to occur within the external infrastructure footprints within the Strategic Assessment Area, outside of the Growth Areas; noting that existing land use and development within the Strategic Assessment Area reduces the likelihood of an unknown population occurring within these corridors.

To address this potential, the Commitments and Measures under the Plan require targeted surveys within suitable habitat along these corridors prior to development. Any population of the Spiny Rice-flower recorded during these surveys would be important to the species. The Plan requires the following avoidance measures to be undertaken should the species be detected:

> *Should a population of the Spiny Rice-flower be recorded within the external infrastructure footprints, any confirmed population or part of the population must be avoided and will be protected, maintained and managed to ensure the persistence of that population in the long-term*

DIRECT IMPACTS

This section provides an analysis of any direct impacts. Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat.

Development under the Plan is unlikely to directly impact the Spiny Rice-flower.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The Plan has the potential to introduce or exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 17 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 17 in order to understand the conclusions reached in this section.

20.2.3 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice (TSSC, 2016b), Recovery Plan (DCCEEW, 2024e) and Significant Impact Guidelines (DEWHA, 2009a) for the Spiny Rice-flower identify a range of threats to the species. Development under the Plan is unlikely to either introduce or exacerbate any of these threats on populations of Spiny Rice-flower that are known to occur within the region. This conclusion is based on the:

- Distance of the majority of known populations from the Growth Areas, which are approximately 12 km west near Bannockburn, approximately 6.3 km north-east past Lara, and approximately 18 km east at the Western Treatment Plant
- Landscape context of these populations, which are surrounded by existing urban development, roads and/or extensive agricultural land
- Mitigation measures which are a requirement of the existing planning system and will address and minimise the standard indirect impacts associated with urban development in the Growth Areas

Refer to Section 17.2 of Chapter 17 for a detailed assessment of potential indirect impacts associated with implementation of the Plan more generally.

Should any additional populations of the species be recorded within either the portion of Heales Road East subject to process based development, or external infrastructure footprints, the commitments under the Plan require a Conservation Management Plan to be prepared to manage avoided values. The plan will address potential indirect impacts associated with the spread of weeds, fire regimes and inappropriate road maintenance works such as slashing, grazing, clearing, herbicide application, and soil disturbance from vehicle traffic.

OFFSETS TO COMPENSATE FOR RESIDUAL ADVERSE IMPACTS

This section identifies any offsets needed to address residual adverse impacts to listed threatened species

Residual adverse impacts to the Spiny Rice-flower are unlikely. As a result, the Plan provides no commitment to the delivery of any species-specific offsets.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice (if applicable) and the Recovery Plan (if applicable), and draws on the analysis of avoidance, impacts and offsets presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 17.3 of Chapter 17.

20.2.4 IMPLICATIONS FOR LONG-TERM VIABILITY AND SUMMARY OF OUTCOMES

Spiny Rice-flower has not been recorded within the Growth Areas, despite targeted surveys. The condition and habitat attributes across the NGGA and WGGA are generally considered to be suboptimal for the species.

There are a number of records within the broader Study Area. The majority of these are associated with populations of the Spiny Rice-flower that are located some distance from the Strategic Assessment Area: to the west of Bannockburn, north-east of Lara, and at the Western Treatment Plant. The Plan will not contribute to or introduce new threats to any of these populations, owing to their distance from the Strategic Assessment Area and the urban and agricultural landscape surrounding them. In this way, these populations are unlikely to be adversely affected by development under the Plan.

There is some potential for the species to occur within the external infrastructure footprints within the Strategic Assessment Area, outside of the Growth Areas; noting that existing land use and development within the Strategic Assessment Area reduces the likelihood of an unknown population occurring within these corridors.

The Plan includes a Commitment to ensure that any new population identified through surveys within the external infrastructure footprints, or the portion of Heales Road East subject to process based development, will be appropriately avoided and managed to ensure the persistence of any such population for the long-term.

Altogether, the Plan is not expected to adversely influence the long-term viability of the Spiny Rice-flower.

20.2.5 CONSISTENCY WITH RECOVERY PLAN

In accordance with Section 146K of the EPBC Act, this section considers whether the implementation of the Plan is not inconsistent with the species' Recovery Plan. It considers two questions:

- Does the Plan prevent achievement of the objectives of the Recovery Plan?
- Does the Plan prevent implementation of the Recovery Plan actions?

These questions are discussed below.

DOES THE PLAN PREVENT ACHIEVEMENT OF THE OBJECTIVES OF THE RECOVERY PLAN?

The overall objectives of the Recovery Plan are to (DCCEEW, 2024e):

- Maintain or increase positive trend in the area of occupancy
- Maintain or increase the number of viable populations (compared to 2021/22 baseline counts)
- Identify, manage and protect all populations of the Spiny Rice-flower from key threats to ensure its persistence
- Maintain and enhance community and institutional support

The Plan will not prevent the achievement of any of the objectives of the Recovery Plan.

DOES THE PLAN PREVENT IMPLEMENTATION OF THE RECOVERY PLAN ACTIONS?

The Recovery Plan identifies a set of actions in order to deliver on the objectives. Each action is associated with performance criteria (DCCEEW, 2024e). The Plan will not prevent the implementation of any of these actions, nor will it prevent the achievement of any of the performance criteria.

20.2.6 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 20-2 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

Table 20-2: Relevant Key Threatening Processes and associated Threat Abatement Plans for Spiny Rice-flower

Key threatening process	Threat abatement plan
Competition and land degradation by rabbits	Threat abatement plan for competition and land degradation by rabbits (DoEE, 2016a)
Fire regimes that cause declines in biodiversity	There is no relevant TAP
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP

21 Listed threatened ecological communities

This chapter assesses the potential impacts of the Plan on ecological communities listed as threatened under the EPBC Act.

The categorisation process identified one TEC which may potentially be impacted by implementation of the Plan. Section 21.1 assesses the potential impacts of the Plan on Natural Temperate Grassland of the Victorian Volcanic Plain.

Refer to Section 12.3 of Chapter 12 for the method used to identify relevant protected matters.

KNOWN TO OCCUR WITHIN THE GROWTH AREAS

21.1 NATURAL TEMPERATE GRASSLAND OF THE VICTORIAN VOLCANIC PLAIN

SPECIES BACKGROUND

This section sets out the basic information about the TEC. It provides a description of the TEC, and an overview of the EPBC definition, distribution and threats. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Critically Endangered
DESCRIPTION	Natural Temperate Grassland of the Victorian Volcanic Plain (Natural Temperate Grassland) is a complex and variable ecological community. Species composition and appearance varies seasonally, between dry and wet periods, and based on local site conditions and management practices (TSSC, 2008). The vegetation of Natural Temperate Grassland is mostly limited to a ground layer of grasses and herbs. Large trees are absent to sparse (TSSC, 2008). The TEC is dominated by a layer of native tussock-forming perennial grasses, including Kangaroo-grass *Themeda triandra*, Wallaby-grasses *Rytidosperma* spp., Spear-grasses *Austrostipa* spp. and Tussock-grasses *Poa* spp.. The spaces between tussock grasses are interspersed with a variety of herbs from the daisy (*Asteraceae*), lily (*Anthericaeae, Asphodelaceae, Phormiaceae*), pea (*Fabaceae*), and orchid (*Orchidaceae*) families (DEWHA, 2008a). Inter-tussock spaces are important for maintaining diversity of this TEC. Where grasses are too dense and crowd inter-tussock spaces, the regeneration of herbs and wildflowers is prevented. Historically, inter-tussock spaces were maintained through a combination of native herbivore grazing and wildfires. It is also possible that the activities of native fauna would have helped to encourage plant germination. However, many native fauna groups have experienced dramatic declines and the functional roles of these species are subsequently decreased. A management regime with periodic disturbance (such as grazing, fire management or slashing) is now required to maintain this TEC (TSSC, 2008). The TEC occurs on Quaternary basaltic plain with scattered volcanic cones and stony rises. It occurs on heavy grey to red cracking clay soils, which tend to be fertile yet with poor drainage. The TEC occurs in a climate characterised by hot, dry summers and cold winters with frost. Mean annual rainfall is between 500 and 700 mm (TSSC, 2008). The TEC provides habitat for many nationally threatened flora species, including Matted Flax Lily *Dianella amoena*, Spiny Rice-flower *Pimelea spinescens* subsp. *spinescens*, and Plains Greenhood *Pterostylis basaltica* (Vranjic, 2008). Natural Temperate Grassland supports skinks, snakes, birds of prey and ground-dwelling birds. The community used to support a range of mammal species, including rodents, macropods and bandicoots, yet this group has substantially declined in remaining remnants of the TEC. Invertebrate fauna is poorly known, aside from the Golden Sun Moth *Synemon plana* (TSSC, 2008).
EPBC DEFINITION	Only patches of the TEC that meet minimum size and condition thresholds are considered part of the TEC under the EPBC Act. Thresholds relate to factors such as patch size, total perennial tussock

	cover, ground cover of native forbs, the cover of non-grass weeds, or whether the patch is contiguous with other native vegetation patches. The Conservation Advice notes that the conservation value of a remnant patch is enhanced if there is a high native plant species richness, the patch is of a large size, there is minimal weed invasion, the patch supports the presence of threatened plant or animal species, there is exposed rock platforms and outcrops, or there are mosses, lichens or a soil crust on the soil surface. Further details of the thresholds are provided in the Listing Advice (TSSC, 2008).
DISTRIBUTION	Natural Temperate Grassland has a very restricted geographic distribution and has declined in extent and community integrity (DEWHA, 2008a). There is less than five per cent of the grassland remaining (Vranjic, 2008). Most known remnants are small (under 10 ha in size) and are highly fragmented (DSEWPaC, 2011a). Further, large remnants (greater than 100 ha) are very rare (TSSC, 2008). The TEC is limited to the basalt plains of Victoria, extending from Melbourne west to Hamilton (DEWHA, 2008a). Most of the remaining Natural Temperate Grassland occurs on private land, with some patches on public land such as roadsides, rail reserves and cemeteries. Good examples of the TEC occur at Craigieburn Reserve, Laverton North Grassland Reserve, and Mortlake Common Flora Reserve (DSEWPaC, 2011a). The TEC is known to occur within 19 reserves although the size of protected patches is unknown. Large grassland remnant patches are protected at Craigieburn Grasslands Reserve, Black's Creek Nature Conservation Reserve, Cobra-Killuc Wildlife Reserve, and Derrimut Grassland Reserve (TSSC, 2008).
THREATS	The Conservation Advice and Listing Advice for the TEC has identified the following threats (DEWHA, 2008a; TSSC, 2008): • Clearing, grazing and burning. • Changes to land management practices of remnants. • Application of herbicides and fertilisers. • Weed invasion. • Poorly managed subdivision, and land use in peri-urban areas. • Lack of knowledge or understanding of grassland remnants.
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for the Natural Temperate Grassland of the Victorian Volcanic Plain (DEWHA, 2008a) Commonwealth Listing Advice on Natural Temperate Grassland of the Victorian Volcanic Plain (TSSC, 2008) Natural Temperate Grassland of the Victorian Volcanic Plain - a nationally threatened ecological community (DEWHA, 2008c) Nationally Threatened Ecological Communities of the Victorian Volcanic Plain: Natural Temperate Grassland & Grassy Eucalypt Woodland (DSEWPaC, 2011a)
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=42

APPROACH TO BASELINE DATA

This section provides an overview of the mapping of the TEC used in the assessment. Please refer to Chapter 13 for further details about baseline data.

HABITAT MAPPING	**WITHIN THE GROWTH AREAS**
	The mapped extent of Natural Temperate Grassland is based on the results of the targeted field surveys (EHP, 2021).
	OUTSIDE THE SURVEYED AREAS OF THE GROWTH AREAS
	There is no specific mapping or modelling available for Natural Temperate Grassland outside of the surveyed areas. For the purposes of this assessment, an indication of distribution and extent of

	the TEC within the unsurveyed areas of the Growth Areas has used DELWP's EVC mapping for EVC 132 (Plains Grassland) (DELWP, 2005). The Listing Advice notes that this EVC is associated with Natural Temperate Grassland although the benchmarks for the EVC do not equate directly with condition thresholds for the TEC (TSSC, 2008). Only a proportion of the modelled extent of the EVC is likely to meet the condition thresholds for the nationally listed community, as discussed further below.

OCCURRENCE IN THE STUDY AREA

This section describes the occurrence of the TEC in the Study Area. It includes reference to a map which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where the TEC occurs.

Refer to Map 21-1 for a map of the TEC across the Study Area, and Map 21-2 for a map of the TEC within the Strategic Assessment Area.

21.1.1 OCCURRENCE WITHININ THE GROWTH AREAS

NATURAL TEMPERATE GRASSLAND WITHIN THE SURVEYED AREAS OF THE GROWTH AREAS

There is 12.7 ha of Natural Temperate Grassland mapped within the surveyed areas of the NGGA. This area is mapped across six patches including (EHP, 2021):

- One patch in the central-north of the NGGA 1 ha in size
- Four patches in the central-east of the NGGA totalling 11.6 ha in size. This includes one contiguous patch 7.5 ha in size. Biosis completed a site visit to this patch in November of 2024, and confirmed that the site still meets the condition thresholds for Natural Temperate Grassland
- One small patch in the south of the NGGA adjacent to Emmersons road 0.1 ha in size

The TEC was not recorded within the WGGA (EHP, 2021).

The Listing Advice identifies patches of higher conservation value to include those with minimal weed invasion, high plant species diversity, and a larger patch size (TSSC, 2008). Areas of the community within the NGGA occur in a heavily modified form and do not meet these requirements for higher conservation value. This is reflected in its Site Condition Habitat Score (a score out of 75) which, when standardised, amounts to totals of either 16 or 24 out of 75 with an understorey score of 5/25. The later reflect the presence of less than 50 per cent of the expected number of lifeforms in this community while still supporting more than a 50 per cent cover of native perennial tussock-grasses.

Examples of the TEC within NGGA typically also have a weed cover of greater than 25 per cent of the vegetation present, with high threat weeds such as Chilean Needle-grass being relatively common. Areas of the TEC with a relatively extensive cover of high threat, perennial, grassy weeds have relatively low resilience to ongoing weed invasion. This makes the Natural Temperate Grassland within the NGGA highly vulnerable to an ongoing rapid decline in condition, to the extent where the occurrences can be expected to fail the required condition criteria to be defined as the community within relatively short timeframes (less than a decade).

NATURAL TEMPERATE GRASSLAND WITHIN THE UNSURVEYED AREAS

Targeted surveys are required to understand the presence or absence of Natural Temperate Grassland. There is potential for the TEC to occur within the unsurveyed areas of the NGGA, with EHP noting that the unsurveyed areas are likely to support ecological values consistent with those already confirmed within the surveyed areas of the Growth Areas (EHP, 2021). The TEC is unlikely to occur within the unsurveyed areas of the WGGA.

DELWP modelling for EVC 132 Plains Grassland (DELWP, 2005) provides a broad indication of the possible distribution of the TEC (TSSC, 2008). However, once condition is taken into account, only a proportion of the modelled EVC extent is likely to meet the condition thresholds for the nationally listed community.

A comparison of the extent of modelled EVC 132 within the surveyed areas of the NGGA, with confirmed Natural Temperate Grassland patches based on surveys, shows that confirmed areas of the TEC account for 5.76 per cent of the modelled EVC extent.

The same factor has been used to estimate the likely extent of the TEC within the unsurveyed areas of the NGGA. This is considered appropriately conservative for the purposes of this assessment given the ecological values within the unsurveyed areas are expected to be broadly consistent, if not reduced, when compared with the broader Growth Areas. These areas generally comprise many small, rural residential landholdings which are fragmented by windrows/landscaping and have a much higher proportion of land use for dwellings and driveways compared to the broader Growth Areas. The environment within these unsurveyed areas tends to be more modified or degraded as a result.

There are approximately 103 ha of the modelled EVC 132 in the unsurveyed areas of the NGGA. Assuming that only 5.76 per cent of this qualifies as Natural Temperate Grassland, there is an estimated 5.9 ha of the TEC within the unsurveyed areas of the Growth Areas. Of this, 2.4 ha is estimated to occur within the portion of Heales Road East subject to process based development.

21.1.2 OCCURRENCE WITHIN THE BROADER STRATEGIC ASSESSMENT AREA AND STUDY AREA

Potential extent of the TEC in the SAA and broader Study Area has been estimated using a modified approach to that used for the unsurveyed areas of the Growth Areas described above.

Based on the modelled occurrence of related EVCs, the Listing Advice estimates that 5,245 ha of the TEC is remaining and that if condition is taken into account, less than 1,000 ha of this is expected to meet the definition of Natural Temperate Grassland (TSSC, 2008). This suggests that approximately 19 per cent of the modelled EVCs are in good enough condition to qualify as Natural Temperate Grassland. This figure is notably larger than the 5.76 per cent calculation generated for the unsurveyed areas of the Growth Areas.

The reasons for this could relate to the land use history and extent of modification within the Growth Areas compared with less developed or intensively farmed areas across its broader distribution. Recognising this, a range estimate of between 5.76 per cent and 19 per cent of modelled EVC 132 has been used to calculate potential extent of the TEC outside of the Growth Areas. This approach provides useful context for the impact assessment and suggests that there is between:

- 21.1 and 69.6 ha of Natural Temperate Grassland within the Strategic Assessment Area (excluding the Growth Areas)
- 827.3 and 2,728.9 ha of Natural Temperate Grassland within the broader Study Area (excluding the Strategic Assessment Area)

AVOIDANCE OF IMPACTS

This section provides an overview of the area of the TEC that was avoided for the species through the design of development within the Growth Areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 16.

Avoidance within the NGGA was determined through a structured decision making process as part of the strategic assessment to identify the optimal layout of development and conservation land in the Growth Area (see Section 16.3 of Chapter 16). A key input to evaluate the biodiversity outcomes of the preferred NGGA layout was the avoidance and protection of Natural Temperate Grassland.

This process led to the avoidance of a total of 10.5 ha (82 per cent) of mapped Natural Temperate Grassland. This includes:

- 6.7 ha of mapped Natural Temperate Grassland in the south-east of the NGGA within the Eastern Conservation Area. This area will be protected and managed as an offset site for NTG. The delivery of this site was a key priority for the avoidance planning process, and has provided for the retention and ongoing management of the largest patch of Natural Temperate Grassland in the NGGA. This represents 53 per cent of the mapped Natural Temperate Grassland within the NGGA
- Retention of 3.7 ha of mapped Natural Temperate Grassland in the gully avoidance area. Part of this area is contiguous with the Eastern Conservation Area, with some smaller fragments mapped throughout the drainage line. This avoidance represents 29 per cent of the mapped Natural Temperate Grassland within the NGGA

The avoidance planning process had to appropriately balance the social, economic and environmental issues relevant to the Growth Areas. Further avoidance of Natural Temperate Grassland was not achievable or appropriate for the following key reasons:

- Further avoidance of the patches in the central-east of the NGGA adjacent to the Eastern Conservation Area was not possible. The Eastern Conservation Area occurs within and adjacent to a drainage line. Avoidance in this area was maximised to the fullest extent, though further avoidance was not possible due to development requirements for urban stormwater management. This is a topographical constraint and there are no viable alternatives that are also conducive to development in the Growth Area
- The avoidance of the small, isolated remaining patches of the TEC in the southern half of the NGGA as pockets of undeveloped land surrounded by urban development would be difficult to deliver from an urban form perspective and difficult to deliver in terms of protecting and managing the TEC values against substantial edge effects
- Avoidance of the patch to the south of the Northern Conservation Area was not considered possible. This patch is isolated and fragmented from other areas of native vegetation or Natural Temperate Grassland. The costs of acquiring and managing this land in addition to the other avoided areas was economically unviable, and was not feasible from an urban form perspective. Avoidance of the larger, and more contiguous patch in the Eastern Conservation Area was prioritised over this patch, and is considered to provide a stronger conservation outcome for the TEC

There is also some potential for the TEC to occur within the external infrastructure footprints within the Strategic Assessment Area, outside of the Growth Areas. The Commitments and Measures under the Plan require:

- Targeted surveys within areas that may support the TEC along these corridors prior to development and
- Demonstrated avoidance of any confirmed areas of the TEC, to the full extent possible

DIRECT IMPACTS

This section provides an analysis of any direct impacts to the TEC. It considers:

- *Predicted impacts within areas identified for development within the Growth Areas*
- *Potential issues associated with fragmentation*

Development under the Plan will lead to the loss of 2.2 ha of mapped NTG, or 17.7 per cent of the TEC mapped within the NGGA. This includes:

- The patch in the central-north of the NGGA. This patch is 1 ha in size
- The small patch in the south of the NGGA adjacent to Emmersons road. This patch is 0.1 ha in size
- One of the four patches in the central-east of the NGGA. This patch is 0.5 ha in size. There will also be partial impacts to two of the other patches in this area (totalling approximately 0.6 ha)

There will also be an estimated loss of 5.5 ha of the TEC within the unsurveyed areas of the NGGA. Of this, it is estimated that 2.4 ha will be impacted across the portion of Heales Road East subject to process based development.

It is relevant to note that the current extent of weeds and apparent declining trend in condition across much of the NGGA suggests that the long-term viability of the remnants is poor if existing land management practices continue. Chilean Needle-grass *Nassella neesiana* is a particular species of concern for the TEC (TSSC, 2008) which is now prolific in some parts of the NGGA. In their assessment of the community, EHP noted that the patches of Natural Temperate Grassland that they identified only met the minimum conditions relating to species diversity and structure (EHP, 2021).

Despite this, it is also recognised that these patches of the TEC still provide conservation value. This reflects the critically endangered status of the community and rate of decline in extent, patch size and condition across its distribution. The loss of the patches within the NGGA will lead to a residual adverse impact which will need to be compensated for. A suitable offset is required, and the strategic delivery of these offsets provides an important opportunity to secure a good conservation outcome for the TEC.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

The Conservation Advice and Listing Advice for Natural Temperate Grassland identify a range of threats to the TEC (DEWHA, 2008a; TSSC, 2008). Development under the Plan is unlikely to influence a number of these threats (such as fertiliser or pesticide use, changes in land management practices, grazing, or a lack of knowledge or understanding of grassland remnants). The following threats to Natural Temperate Grassland are potentially relevant to development under the Plan and are discussed below:

- Weed invasion
- Burning

The TEC is most vulnerable to indirect impacts associated with these threats within the Eastern Conservation Area, and the gully avoidance area.

WEED INVASION

Weed invasion is identified as a threat to Natural Temperate Grassland. Exotic weeds compete for resources and space in inter-tussock gaps, and can reduce the diversity of native herbs. Perennial exotic grasses are of particular concern because they are often difficult to manage and can have long-term effects. Perennial weeds including Chilean needle-grass, phalaris, and Yorkshire fog are known to have a high impact on the TEC (TSSC, 2008).

The Plan is unlikely to exacerbate this threat. Weed invasion is a significant existing issue in the Growth Areas, as reported by EHP, landholder surveys and more recent site observations. Development activities are unlikely to influence the spread of weeds in a way that notably impacts the TEC

Standard weed management protocols are a requirement of development through the existing planning system, and are expected to manage potential indirect impacts associated with this threat.

Further, the areas of Natural Temperate Grassland which are retained and protected in the Eastern Conservation Area will be subject to management to improve the condition of the TEC. A conservation interface will be established between urban development and the Conservation Area to mitigate potential edge effects, including weeds. This measure will be delivered through Commitment 14, which requires a list of actions to be implemented as part of development to mitigate the indirect impacts of development on the Eastern Conservation Area.

Refer to Section 17.2.3 of Chapter 17 for a detailed assessment of potential indirect impacts associated with the spread of weeds under the Plan.

BURNING

Fire that is too frequent, or in the wrong season, may result in the loss of fire-sensitive species and reduction in floristic diversity (TSSC, 2008).

The Plan is considered unlikely to notably change or contribute to this threat in the Growth Areas or more broadly given the existing level of development in the Greater Geelong region. The planning system has existing standard mitigation measures in place to address the risk of altered fire regimes and increased fire risk from development. This includes a broad requirement to ensure development can implement bushfire protection measures without unacceptable impacts to biodiversity through appropriate planning.

In addition, the conservation interface established between urban development and the Eastern Conservation Area, as well as the ongoing management within the Conservation Area itself, will provide for appropriate fire management to protect Natural Temperate Grassland.

Refer to Section 17.2.5 of Chapter 17 for a detailed assessment of potential indirect impacts associated with inappropriate fire regimes under the Plan.

OFFSETS TO COMPENSATE FOR RESIDUAL ADVERSE IMPACTS

This section identifies any offsets needed to address residual adverse impacts to the TEC.

21.1.3 OFFSETS FOR RESIDUAL IMPACTS WITHIN THE GROWTH AREAS

The Plan will provide the following package of offsets to compensate for direct impacts to the TEC within the NGGA:

- Protection and ongoing management of 13.9 ha of areas supporting the TEC. This includes:
  - 6.7 ha within the Eastern Conservation Area in the NGGA
  - 7.2 ha outside of the Growth Areas
- Strategic delivery of these offsets, which means:
  - Coordinated offset delivery within the NGGA: Around 49 per cent of the offset target for Natural Temperate Grassland will be delivered within the Eastern Conservation Area. This is a key outcome of the strategic avoidance planning process, and provides in-situ protection of a notable patch of the TEC, local to the areas impacted by development under the Plan
  - Spatially planned offsets: External offsets will meet at least one of the following strategic landscape criteria:
    - Protection of areas supporting Natural Temperature Grassland that would be considered large for the community
    - Located within a key biodiversity corridor and improves connectivity across the landscape
    - Connection of the offset site to an existing conservation reserve

As outlined previously, strategic approaches to offsets such as this, can lead to outcomes that are in the order of 20-40 per cent better than non-strategic offsets (Gordon *et al.*, 2011; Gordon and Peterson, 2019).

The offset package delivered under the Plan does not account for potential impacts to habitat within the portion of Heales Road East subject to process based development. Surveys will be undertaken to determine the presence of MNES values in these areas prior to development. Important or notable occurrences of Natural Temperate Grassland will be avoided, protected, and maintained to ensure persistence. Any unavoidable clearing of confirmed areas of Natural Temperate Grassland within this area will be offset in accordance with the EPBC Act Environmental Offsets Policy and associated Offsets Assessment Guide (Commonwealth of Australia, 2012b). Further details on this process are provided in Section 8.6 of Part 2.

In addition, any unavoidable clearing of confirmed areas of the TEC within the external infrastructure footprints will be offset in accordance with the EPBC Act Environmental Offsets Policy and associated Offsets Assessment Guide (Commonwealth of Australia, 2012b). Given the existing level of development and land use in these areas, and the need to demonstrate avoidance to the full extent possible under the Plan, the potential level of clearing and associated need for offsets is expected to be minimal.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the TEC. The assessment of viability has regard for the guidance in the Conservation Advice and Listing Advice and draws on the analysis of avoidance, impacts and offsets presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 17.3 of Chapter 17.

21.1.4 IMPLICATIONS FOR LONG-TERM VIABILITY AND SUMMARY OF OUTCOMES

A total of 12.7 ha of Natural Temperate Grassland has been mapped across the Growth Areas. All of this occurs within the NGGA and is comprised of a number of small, fragmented patches. The most consolidated patches account for 92 per cent of this area, comprising four closely located patches in the central east of the NGGA totalling 11.6 ha. The remaining two patches are smaller and more fragmented. In addition, there is a conservative estimate of 5.9 ha of potential Natural Temperate Grassland within the unsurveyed areas of the Growth Areas.

The avoidance planning process prioritised the avoidance of Natural Temperate Grassland, and led to the avoidance of a total of 10.5 ha of the TEC that has been mapped within the NGGA. Overall, 82.29 per cent of the mapped NTG within the NGGA will be avoided. This includes the protection and management of the largest patch of Natural Temperate Grassland within the NGGA in the Eastern Conservation Area.

Development under the Plan will lead to the loss of 2.2 ha of mapped NTG, and 5.5 ha of estimated TEC within unsurveyed areas. This represents the loss of three patches of NTG, and partial impacts to two patches of the TEC.

It is noted that the ongoing agricultural land management and extensive threat from existing weeds, including Chilean Needle-grass, threaten the long-term viability of these remnants. At the time of surveys, EHP noted that the patches of mapped Natural Temperate Grassland only met the minimum condition thresholds for the EPBC community (EHP, 2021). Notable declines in native grassland condition and extent have been observed at some locations across the NGGA since that time (see Chapter 13, Section 13.2 for details).

However, as identified in the Listing Advice, even small, degraded patches of the TEC retain biodiversity value. To compensate for the impacts to the community, the Plan commits to the delivery of an offsets package for the TEC which:

- Addresses the clearing within the NGGA with an offset quantum of 13.9 ha. Of this, 6.7 ha will be delivered in the Eastern Conservation Area, and 7.2 ha will be delivered outside of the Growth Areas
- Aims to identify consolidated patches of the TEC for protection in strategic locations; noting that larger remnants are now very rare across the TECs distribution, making any remaining large patches particularly important to the long viability of the community as a whole
- Will lead to the early protection and management of the offset sites, in advance of many impacts. The benefits of early or advanced offsetting in this context has been demonstrated in a number of studies (Gordon *et al.*, 2011; Gordon and Peterson, 2019)
- Will ensure that any unavoidable clearing of confirmed areas of the TEC within the external infrastructure footprints will be offset in accordance with the EPBC Act Environmental Offsets Policy and associated Offsets Assessment Guide (Commonwealth of Australia, 2012b)

When balanced against the condition, size and existing threats to the remnants within the NGGA, the offsets for Natural Temperate Grassland that will be delivered under the Plan are expected to lead to an improved long-term outcome for the community.

21.1.5 CONSISTENCY WITH RECOVERY PLAN

There is no Recovery Plan for the TEC.

21.1.6 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 20-1 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

Table 21-1: Relevant Key Threatening Processes and associated Threat Abatement Plans for Adamson's Blown Grass

Key threatening process	Threat abatement plan
Fire regimes that cause declines in biodiversity	There is no relevant TAP
Land clearance	There is no relevant TAP

22 Ramsar wetlands

22.1 INTRODUCTION

The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site (the Ramsar site) occurs partially within the Study Area, with two sections occurring downstream from the growth areas.

This chapter sets out:

- Australia's international conservation obligations regarding the Ramsar site
- A general description of the Ramsar site
- The Ramsar listing criteria
- A summary of the ecological character of the Ramsar site
- How the Growth Areas relate to the Ramsar site
- An analysis of potential direct and indirect impacts
- An analysis of how the Plan addresses obligations under the Ramsar convention

22.2 REGULATORY CONTEXT

22.2.1 INTERNATIONAL AGREEMENTS AND OBLIGATIONS

Australia is party to a number of international agreements and treaties which require protection of significant wetlands and habitat for migratory birds. These include (DELWP, 2018, 2020):

- The Ramsar Convention on Wetlands
- The Convention on the Conservation of Migratory Species of Wild Animals (Bonn)
- The Japan - Australia Migratory Bird Agreement (JAMBA)
- The China - Australia Migratory Bird Agreement (CAMBA)
- The Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)
- The East Asian - Australasian Flyway Partnership (EAAFP)

The Ramsar Convention aims to prevent the degradation and loss of important wetlands across the globe through requiring implementation of appropriate site management and conservation principles. Section 22.8 discusses how obligations under the Ramsar Convention have been addressed.

The Bonn Convention is an environmental treaty of the United Nations and aims to conserve migratory species within their migratory ranges. The Bonn convention is the only global convention which specialises in the conservation of migratory species, their habitats and migration routes. As of 1 November 2019, there were 130 Parties to the Convention.

JAMBA, Bonn, CAMBA and ROKAMBA are bilateral agreements which provide for protection of migratory birds and their important habitats.

The EAAFP is an informal and voluntary initiative which aims to protect migratory waterbirds and their habitats. Members of EAAFP include countries, intergovernmental agencies, NGOs, and the international business sector.

22.3 GENERAL DESCRIPTION OF THE RAMSAR SITE

The Ramsar site is located across six distinct areas and covers an area of 22,652 hectares (see Map 22-1). The six areas are (DELWP, 2020):

- Point Cook / Cheetham (420 hectares)
- Werribee / Avalon (14,592 hectares)
- Point Wilson / Limeburners Bay (942 hectares)
- Swan Bay (2,660 hectares)
- Mud Islands (625 hectares)
- Lake Connewarre (3,412 hectares)

The Ramsar site supports a diversity and abundance of waterbird species, along with native fish and frogs. It also supports the Subtropical and Temperate Coastal Saltmarsh TEC which is listed as vulnerable under the EPBC Act. The Ramsar site is comprised of the following 12 wetland types (DELWP, 2020):

- Permanent shallow marine waters: this includes the seaward boundary which provides sub-tidal areas of permanent inundation within the Ramsar site
- Marine subtidal aquatic beds: this includes extensive area of seagrass in Swan Bay and Mud Islands, and areas of kelp / macro-algal beds in the Werribee sector
- Intertidal marshes: this includes extensive areas of intertidal saltmarsh in Lake Connewarre, Hospital Swamp, Swan Bay, Mud Islands, Point Wilson, and the shorelines of Werribee and Point Cooke
- Wastewater treatment areas: this comprises the Western Treatment Plant
- Salt exploitation sites: this comprises the Cheetham wetlands which are no longer used for harvest
- Intertidal mud, sand or salt flats: this includes areas around Mud Islands and Swan Bay
- Seasonal intermittent freshwater marshes / pools on inorganic soils: this includes Reedy Lake and Ryan's Swamp
- Intertidal forested wetlands: this includes small areas of mangrove along Limeburners Bay and the Barwon Estuary
- Sand, shingle or pebble shores: this includes beach areas along the Werribee shoreline, Swan Bay and around Mud Islands
- Estuarine waters: this includes Barwon Estuary and Limeburners Bay
- Permanent rivers, streams and creeks: this includes the Barwon River and Little River
- Rocky marine shores: this includes small areas near Point Wilson and Point Cooke

The Ramsar site is managed primarily by DELWP, Parks Victoria, Melbourne Water, and the Department of Defence (DELWP, 2020).

DELWP is currently running a process to review the boundaries of the Ramsar site (DELWP, 2022). This includes consideration of adding a number of additional wetlands to the listing. All of the proposed additions broadly occur within the same vicinity as the six areas that are currently part of the Ramsar site. Given the similar locations and values of these wetlands to the existing site, the impact assessment presented in this chapter broadly addresses the threats and pressures that may be relevant due to implementation of the Plan.

22.4 RAMSAR LISTING CRITERIA

The Ramsar site was listed as a Wetland of International Importance under the Ramsar Convention in 1982. For a wetland to be designated as a Ramsar site it must satisfy one or more of the Ramsar listing criteria. The Ramsar site meets criteria 2, 3, 4, 5, and 6 (see Table 22-1). Note that these criteria have changed since the original listing in 1982 due to administrative changes (DELWP, 2020).

Table 22-1: Criteria for Ramsar listing (DELWP, 2020)

Criterion	Justification
Criterion 2 - *A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities*	The Ramsar site regularly supports one threatened ecological community and 13 threatened fauna species, including: • Subtropical and Temperate Coastal Saltmarsh TEC • Australasian Bittern (*Botaurus poiciloptilus*) • Australian Fairy Tern (*Sternula nereis nereis*) • Bar-tailed Godwit (*Limosa lapponica baueri*) • Curlew Sandpiper (*Calidris ferruginea*) • Eastern Curlew (*Numenius madagascariensis*) • Great Knot (*Calidris tenuirostris*) • Greater Sand Plover (*Charadrius leschenaultia*) • Hooded Plover (*Thinornis rubricollis rubricollis*) • Lesser Sand Plover (*Charadrius mongolus*) • Red Knot (*Calidris canutus*) • Orange-bellied Parrot (*Neophema chrysogaster*) • Australian Grayling (*Prototroctes maraena*) • Growling Grass Frog (*Litoria raniformis*)
Criterion 3 - *A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region*	The Ramsar site provides a diversity of waterbird habitats, and a total of 120 species of waterbird have been recorded within the Ramsar site. The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site represents the most species rich Ramsar site in the South East Coast (Victoria) Drainage Division with respect to waterbirds when compared to other large marine and costal wetland systems in the bioregion
Criterion 4 - *A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions*	The Ramsar site supports a diversity of species throughout critical life stages, including: • Migration - There are over 30 international migratory shorebirds recorded in the Ramsar site. Further, the Ramsar site regularly supports 22 species during the summer non-breeding months. The Barwon River Estuary also provides a migratory corridor for a number of native diadromous fish species • Drought refuge – The permanent freshwaters of the Western Treatment Plant lagoon and reedy Lake provide refuge for waterfowl and other native species when other temporary wetland systems are dry • Breeding – The Ramsar site supports breeding of at least 49 species of waterbirds, marine fish, and native frogs • Moulting – the Western Treatment Plant supports large numbers of moulting waterfowl, over 30,000 birds have been recorded in primary moult at this site
Criterion 5 - *A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds*	Waterbird counts across the Ramsar site are very high, a sum of maximum annual abundance indicated that the Ramsar site has supported >20,000 waterbirds each year since 1981. This is a conservative estimate, and a maximum of over 300,000 birds were recorded in 1993
Criterion 6 - *A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird*	At the time of listing, 13 species met this criterion. More recent estimates (2000 – 2019) indicate that the Ramsar site supports > 1% of the population of 15 species

By designating the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula as a Ramsar site, Australia is obligated to establish and implement a management framework that aims to conserve the wetland and ensure its wise use. 'Wise use' under the Convention is broadly defined as maintaining the 'ecological character' of the wetland (see Section 22.5 for an overview of ecological character) (DEWHA, 2008b).

22.5 SUMMARY OF THE ECOLOGICAL CHARACTER

22.5.1 OVERVIEW OF ECOLOGICAL CHARACTER

Ecological character is defined under the Ramsar Convention as the combination of the ecosystem components, processes, benefits and services that characterise a wetland at a given point in time (Ramsar Convention, 2005). It provides a baseline description of the wetland at the time of listing and often incorporates limits of acceptable change (LAC). LACs are the "range of variation in the components, processes and benefits or services that can occur without causing a change in the ecological character of the site" (DEWHA, 2008b).

Ecological character is also the main element for the consideration of significant impacts under the EPBC Act. The significant impact guidelines (DoE, 2013) state that:

An action is likely to have a significant impact on the ecological character of a declared Ramsar wetland if there is a real chance or possibility that it will result in:

- *areas of the wetland being destroyed or substantially modified*
- *a substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland*
- *the habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected*
- *a substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health, or*
- *an invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland.*

This assessment uses these guidelines to discuss the potential impacts to the Ramsar site.

22.5.2 ECOLOGICAL CHARACTER OF THE PORT PHILLIP BAY (WESTERN SHORELINE) AND BELLARINE PENINSULA RAMSAR SITE

The Ecological Character Description of the Ramsar site identifies the critical components, processes, services and benefits of the Ramsar site, along with the limits of acceptable change (DELWP, 2020).

Table 22-2 provides a high-level summary of the ecological character of the Ramsar site.

Table 22-2: High level summary of the ecological character of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site (adapted from (DEWHA, 2008b)**)**

Component of ecological character	Key points	Limits of acceptable change
Critical components and processes		
Hydrology	The following aspects of hydrology are considered critical to the ecological character: • Interaction between freshwater inflows and tidal exchange in the Lake Connewarre Complex • Artificial water regimes which maintain the highly productive lagoons of Cheetham Wetlands and the Western Treatment Plant	• Reedy Lake will not be continuously wet for more than 10 continuous years, or continuously dry for more than five • At least 75% of aerobic treatment lagoons at the Western Treatment Plant will contain permanent water • At least 75% of the lagoons at Cheetham will contain permanent water
Vegetation	Vegetation in the Ramsar site includes: • Seagrass: present in the Mud Islands, Swan Bay, and coastal areas adjacent to Point Wilson/Limeburners Bay • Saltmarsh: seven communities are present, dominated by shrubs of the genera *Tecticornia* and *Sarcocornia* • Mangroves: a small area in the Barwon Estuary • Freshwater wetland vegetation: including tall marsh and lignum shrubland at Reedy Lake, and a variety of emergent, submerged, and floating aquatic species in parts of the Western Treatment Plant	• Seagrass - Seagrass extent will not fall below 1,500 hectares for a period of greater than 20 continuous years • Saltmarsh - Total saltmarsh extent will not fall below 900 hectares • Mangroves - Total mangrove extent will not fall below 40 hectares • Freshwater wetland vegetation - A habitat mosaic will be maintained at Reedy Lake that comprises open water, emergent native vegetation (sedges, rushes, and reeds) and lignum shrubland with no habitat comprising more than 70 percent of the total wetland area for more than five successive years
Native fish	The Ramsar site supports a variety of native fish, including: • Freshwater fish in Little River, the Western Treatment Plant, and Lake Connewarre • Diadromous fish, including the Australian Grayling which has been recorded in Lake Connewarre • Marine and estuarine fish	• A minimum of 3 fish species per standard haul of a 10 m seine net from three replicate hauls in subtidal habitats of Swan Bay • A minimum abundance of 5 fish per standard haul of a 10 m seine net from three replicate hauls in subtidal or intertidal habitats of Swan Bay

Component of ecological character	Key points	Limits of acceptable change
Waterbird diversity and abundance	The Ramsar site supports over 120 species of wetland dependant bird, including 22 regularly recorded migratory shorebirds. At the time of listing, the annual maximum abundance was ~180,000 birds	Abundance and diversity of waterbirds will not decline below the following where abundance is calculated as a rolling five-year average of maximum annual count, and diversity is calculated as a rolling five-year average of number of species: • Total waterbirds – 100,000 (abundance), 70 (diversity) • Migratory waders - 20 (diversity) • Australasian waders – 1,500 (abundance), 10 (diversity) • Ducks – 30,000 (abundance), 10 (diversity) • Fish eating species – 2,250 (abundance), 12 (diversity) • Herbivores – 6,000 (abundance), 2 (diversity) • Double-banded plover – 1 % (abundance) • Red-necked stint – 1 % (abundance) • Sharp-tailed sandpiper – 1.5 % (abundance) • Gulls – 2 (diversity) • Large bodied waders – 7 (diversity) • Other – 2 (diversity)
Waterbird breeding	At least 49 species of wetland dependent birds have been recorded breeding at the Ramsar site. Beach nesting species have been recorded breeding at Cheetham Wetlands and on Mud Islands, and a number of waterfowl breed at the Western Treatment Plan	• Annual breeding at Mud Islands of colonial nesting species of at least 25,000 pairs / nests. Presence of all of the following species breeding in at least three in every five years: Australian pelican, Australian pied oystercatcher, Australian white ibis, crested tern, little pied cormorant, pied cormorant, silver gull, straw-necked ibis, and white-faced storm petrel. • Annual breeding at Western Treatment Plant of > 300 pairs of Pied Cormorant
Supporting components and processes		
Climate	Climate has an important role in the ecology of the Ramsar site. Rainfall occurs year-round and the annual average is in the order of 500 mm per year, evaporation exceeds rainfall year-round	N/A

Component of ecological character	Key points	Limits of acceptable change
Geomorphic setting	The Geomorphology exerts a strong influence on surface and groundwater connections. Port Phillip Bay is a circular embayment with a narrow connection to the Southern Ocean. The marine areas of the Ramsar site are in the shallow depth contour (< 2 m). There are six sites of geomorphic significance in the Ramsar site, including Mud Islands, the Spit and Edwards Point	N/A
Water quality – salinity, nutrients, water clarity	The salinity within the Ramsar site ranges from predominantly fresh at the Western Treatment Plant and parts of Lake Connewarre, to hypersaline at Cheetham Wetlands Water clarity has an important ecological role, in the shallow marine waters, between 40 – 50 per cent of surface irradiance reaches the sea floor Nitrogen is a significant nutrient in the Ramsar site, sourced primarily from Western Treatment Plant and the Yarra River	N/A
Critical services and benefits		
Provides physical habitat (for waterbirds)	The Ramsar site provides habitat for waterbird feeding, roosting, moulting, and breeding. The Ramsar site supports a wide range of functional groups (i.e., shorebirds, ducks, fish-eaters, large-bodied waders) each with different habitat requirements	• Australasian Bittern, Bar-tailed Godwit, Eastern Curlew, Great Knot, Hooded Plover, Lesser Sand Plover, and Red Knot recorded within the Ramsar site in three out of five seasons. • Abundance of waterbirds will not decline below the following (calculated as a rolling five year average of maximum annual count; percentages calculated based on Hansen et al. (2016) for migratory shorebird species and the latest Wetlands International Waterbird Population for other species): o Australian Fairy Tern – 0.6 % o Curlew Sandpiper – 1.7 %
Provides nursery habitat for native fish	The saltmarsh and seagrass communities in Swan Bay provide nursery habitat for juvenile fish, including the larval stages of some fish species including King George Whiting, Blue Rock Whiting, Leatherjackets and Pipefish	The LAC for native fish is captured in the LACs for saltmarsh and seagrass

Component of ecological character	Key points	Limits of acceptable change

Threatened wetland species and ecosystems	The Ramsar site provides important habitat for 13 species of threatened fauna, including seven international migratory shorebirds. The commonwealth listed Subtropic and Temperate Coastal Saltmarsh community is also present within the Ramsar site	• Orange-Bellied Parrot – captured in the LAC for saltmarsh
		• Australian Grayling - Australian Grayling continues to be supported in the Barwon River system
		• Growling Grass Frog:
		  ○ At Western Treatment Plant > 200 Growling Grass Frogs in 3 out of 5 years
		  ○ Presence of Growling Grass Frog in the Lake Connewarre complex in 3 out of 5 years

Ecological connectivity	There are a range of distinct wetland types within the Ramsar site which are ecologically connected. In particular, the connection between marine, estuarine and freshwater components is significant for fish migration and reproduction. The Ramsar site also supports significant numbers of migratory shorebirds	• Connectivity between the Barwon River and the Southern Ocean is not impeded between March and November for more than two consecutive years
Cultural services		
Recreation, education, and tourism	There are various uses of the Ramsar site including: • Hunting of ducks between March and June in the freshwater areas of Reedy Lake • Fishing and bird watching at the Western Treatment Plant and the Cheetham Wetlands • The Marine and Freshwater Discovery Centre	N/A
Aboriginal cultural values	The Ramsar site is important to two Indigenous language groups. Mud islands and the area east of the Werribee is Boonwurrung country, and the remainder of the site is Wathaurong country There are a number of important sites including middens, artefacts and burial sites within the Ramsar site. The Lake Connewarre Complex is a significant for the Wathaurong people	N/A

Component of ecological character	Key points	Limits of acceptable change
Scientific research	The proximity of the Ramsar site to larger cities provides opportunities for research. Various research projects are functioning within the Ramsar site, including: • The Fisheries Research Facility (run by the Victorian Fisheries Authority) • Research on the Western Treatment Plant and surrounding shorelines (run by Melbourne Water) • Monitoring of shorebirds occurs at a number of locations within the Ramsar site	N/A

22.6 HOW THE GROWTH AREAS RELATE TO THE RAMSAR SITE

Three of the six areas that form the Ramsar site occur within the Study Area. They are:

- Point Wilson / Limeburners Bay (see Map 22-2)
- The Lake Connewarre Complex (see Map 22-3)
- Werribee / Avalon (see Map 22-4)

Point Wilson / Limeburners Bay and the Lake Connewarre Complex occur downstream of the Growth Areas. The connection between the Growth Areas and these sections of the Ramsar site is discussed below.

The Werribee / Avalon section of the Ramsar site is not hydrologically connected to the Growth Areas.

22.6.1 POINT WILSON / LIMEBURNERS BAY

Approximately 52 per cent of the NGGA drains east to Point Wilson / Limeburners bay via Hovells Creek, which passes through the town of Lara before connecting to Limeburners Bay. This section of the NGGA is approximately 1,088 ha in size, or approximately 4.6 per cent of the total size of the Hovells Creek catchment.

The hydrological distance between the Ramsar site and the NGGA is approximately 9 – 10 km (stream length).

22.6.2 THE LAKE CONNEWARRE COMPLEX

The Lake Connewarre Complex occurs downstream of both the WGGA and a small section of the NGGA. The WGGA is connected to this area of the Ramsar site via the Moorabool River (a tributary of the Barwon River) which flows to the Lake Connewarre Complex south of Geelong. The hydrological distance of the WGGA to the site is approximately 25 km (stream length).

The small section of the NGGA is connected to this area of the Ramsar site via Sutherland Creek, a tributary of the Moorabool River, which then connects to the Barwon River and Lake Connewarre Complex. The hydrological distance between this area of the Ramsar site and the NGGA is approximately 41 km (stream length). The section of the Barwon river that occurs downstream of the Growth Areas passes by Batesford Quarry and through the southern part of Geelong.

Approximately 39 per cent of the WGGA and 2 per cent of the NGGA will drain to the Lake Connewarre Complex.

22.6.3 WERRIBEE / AVALON

The Werribee / Avalon section of the Ramsar site does not occur downstream of the Growth Areas and is therefore not hydrologically linked to development. However, the southern section is approximately 8 km from the NGGA and will potentially experience increased visitation for recreational reasons as a result of new urban development in the area.

22.7 ANALYSIS OF POTENTIAL IMPACTS

22.7.1 DIRECT IMPACTS

The Ramsar site is located outside of the Strategic Assessment Area (see Map 22-1) and will not be subject to any direct impacts as a result of implementing the Plan.

22.7.2 INDIRECT IMPACTS

There are a number of potential threats to the Ramsar site outlined in the Ecological Character Description (DELWP, 2020). Table 22-3 below outlines the priority threats to the three areas of the Ramsar site that occur within the Study Area and identifies which threats are relevant to potential indirect impacts under the Plan.

A detailed discussion of potential indirect impacts under the Plan is provided below.

Table 22-3: Priority threats at the relevant locations of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site (DELWP, 2020)

Threat	Relevant areas of the Ramsar site*			Description of threat	Potential impacts pathways under the Plan
	Point Wilson / Limeburners	Werribee / Avalon	Lake Connewarre		
Climate change: sea level rise impacting on intertidal vegetation and waterbird habitat	✓✓	✓✓	✓✓	Sea level rise has the potential to impact saltmarsh, intertidal habitats, and waterbirds. Saltmarsh and mangrove community composition and extent is largely determined by the depth and frequency of tidal inundation (DELWP, 2020)	The potential impacts of climate change and relevant mitigation measures under the Plan are outlined in Section 29.5 of Chapter 29
Climate change: increased temperature increases the frequency and severity of avian disease		✓✓		Increased temperatures are likely to have direct impacts to biota, including the increased risk of avian diseases under warmer conditions (DELWP, 2020)	The potential impacts of climate change and relevant mitigation measures under the Plan are outlined in Section 29.5 of Chapter 29
Climate Change: increased intensity of storms resulting in erosion of shoreline habitats		✓✓		The increased frequency and intensity of storms is a greatest threat to areas already experiencing erosion (DELWP, 2020)	The potential impacts of climate change and relevant mitigation measures under the Plan are outlined in Section 29.5 of Chapter 29
Changed operations at the Western Treatment Plant decreasing nutrients and carbon	✓	✓✓		Treated wastewater is discharged from the Western Treatment into the Ramsar site. Although counter intuitive, there is significant scientific understanding of the importance of the productivity driven by discharges from the Western Treatment Plant on shorebird diversity and abundance (DELWP, 2020)	The Plan will not interact with the operations of the Western Treatment Plant
Toxicants from catchment inflows and stormwater	✓	✓✓	✓	Stormwater and catchment inflows are often the source of nutrients, sediments, or toxicants discharging into the Ramsar site (DELWP, 2020)	Point Wilson / Limeburners Bay and the Lake Connewarre Complex occur downstream of the growth areas. Potential indirect impacts to water quality are discussed below

Threat	Relevant areas of the Ramsar site*			Description of threat	Potential impacts pathways under the Plan
	Point Wilson / Limeburners	Werribee / Avalon	Lake Connewarre		
Emerging chemicals of concern from the Western Treatment Plant	✓	✓✓		Urban treated sewage contains a range of chemicals including steroid hormones which may impact fauna in the Ramsar site (DELWP, 2020)	The Plan will not interact with the operations of the Western Treatment Plant
Stormwater results in decreased salinity and altered water regimes			✓✓	Stormwater and catchment inflows are often the source of nutrients, sediments, or toxicants discharging into the Ramsar site (DELWP, 2020)	The Lake Connewarre Complex occurs downstream of the Growth Areas. Potential indirect impacts to water quality are discussed below
Urban development: direct habitat removal and loss of buffer	✓	✓	✓✓	The predicted increase in the Greater Melbourne population is a pressure to the Ramsar site. Urban encroachment results in the loss of wetland buffers, and at times, the boundary of the Ramsar site (DELWP, 2020)	The Plan will not result in habitat removal at any of the areas of the Ramsar site
Litter (including micro-plastics) effects biota	✓✓	✓		Recent studies have indicated there is a large amount of micro-plastic and litter on the beaches of Port Phillip Bay. Ingestion of litter is threat to biota in the Ramsar site (DELWP, 2020)	Urban development may increase levels of visitation to the areas of the Ramsar site within the Study Area. The issues associated with recreational use of the Ramsar site are discussed further below
Invasive species: foxes and cats predating on waterbirds	✓	✓	✓✓	Predation by foxes and cats are a significant threat to shorebirds and beach nesting birds. Foxes remain widespread throughout the Ramsar site (DELWP, 2020)	The Plan is not likely to exacerbate the threat of invasive fauna to the Ramsar site. The areas that form the Ramsar site occur a distance from the Growth Areas, and these locations are already surrounded by urban development
Invasive species: salt tolerant weeds impacting saltmarsh and waterbird habitat	✓✓	✓	✓✓	A number of salt tolerant weeds have been recorded in Port Phillip Bay. These weeds impact both saltmarsh communities, and the biota that use saltmarsh and intertidal flats as habitat (DELWP, 2020)	The Plan is not likely to exacerbate the threat of invasive flora to the Ramsar site. The areas that form the Ramsar site occur a distance from the Growth Areas, and these locations are already surrounded by urban development

Threat	Relevant areas of the Ramsar site*			Description of threat	Potential impacts pathways under the Plan
	Point Wilson / Limeburners	Werribee / Avalon	Lake Connewarre		
Invasive species: non-native grazing animals (rabbits and deer) impacting vegetation and habitat	✓	✓	✓✓	Rabbits are widespread throughout the coastal areas of Port Phillip Bay, and cause damage to native vegetation through grazing and digging. Grazing from deer in the Lake Connewarre Complex can cause extensive damage to habitats and saltmarsh (DELWP, 2020)	The Plan is not likely to exacerbate the threat of invasive fauna to the Ramsar site. The areas that form the Ramsar site occur a distance from the Growth Areas, and these locations are already surrounded by urban development
Recreation: boats, jets skis, kite surfers disturbing waterbird feeding, breeding, and roosting	✓✓	✓	✓	Disturbance from shore based or nearshore boating activities is a high risk to waterbirds in the Ramsar site. The consequences for populations and individuals can include decreased time spent feeding, increased energy spent flying away from disturbances, nest abandonment and general population declines (DELWP, 2020)	Urban development may increase levels of visitation to the areas of the Ramsar site within the Study Area. The issues associated with recreational use of the Ramsar site are discussed further below
Recreation: walkers, horse-riding disturbing waterbird feeding, breeding, and roosting	✓✓	✓	✓	Disturbance of waterbirds by human activities can negatively impact feeding behaviour and habitat use. The consequences for populations and individuals can include decreased time spent feeding, increased energy spent flying away from disturbances, nest abandonment and general population declines (DELWP, 2020)	Urban development may increase levels of visitation to the areas of the Ramsar site within the Study Area. The issues associated with recreational use of the Ramsar site are discussed further below
Recreation: vehicles damaging saltmarsh			✓✓	Vehicle damage to saltmarsh communities has been reported across the Ramsar site. Saltmarsh communities are slow recovering, and damage can range from subtle, to severe (DELWP, 2020)	Urban development may increase levels of visitation to the areas of the Ramsar site within the Study Area. The issues associated with recreational use of the Ramsar site are discussed further below
Duck hunting impacts to non-target species	✓✓	✓✓	✓✓	Hunting is permitted in areas of the Ramsar site, primarily between March and June. This overlaps with the presence of migratory shorebirds and Orange-bellied Parrots. Impacts to non-target species in the Ramsar site are a concern (DELWP, 2020)	Urban development may increase levels of visitation to the areas of the Ramsar site within the Study Area. The issues associated with recreational use of the Ramsar site are discussed further below

*Note that '✓✓' indicates the highest priority threats for each location

Based on the threats to the Ramsar site identified in the Ecological Character Description (DELWP, 2020), relevant potential indirect impacts under the Plan can be summarised as:

- Changes to water flows and quality
- Disturbance from increased public access to natural areas

An assessment of these indirect impacts is provided below.

CHANGES TO WATER FLOWS AND QUALITY

Mechanism of impact

The Plan has the potential to impact on water flows and quality in the following ways (US EPA, 2022):

- Increased impermeable surfaces in developed areas reduces infiltration and increases surface runoff volumes during rain events
- The speed and efficiency of surface runoff flows to streams can be increased by stormwater drainage infrastructure
- Vegetation removal can reduce evapotranspiration

Urbanisation can subsequently increase the frequency, magnitude and duration of high flow events, increase the speed of flow and likelihood of flash flooding, and decrease the lag time of flows (meaning that a flow event finishes more quickly). Stream flow characteristics during low flow periods can also be affected (US EPA, 2022).

Urban development can also impact upon water quality through polluting runoff. Stormwater from urban areas contains a range of pollutants, including sediments, nutrients, organics, heavy metals, bacteria, viruses, and litter (Shahzad *et al*., 2022).

How impacts can affect the Ramsar site

Water flows and quality in the Ramsar site may be affected through development in the areas of the WGGA and NGGA that are hydrologically linked. As outlined previously, this relates to Limeburners Bay (via Hovells Creek) and the Lake Connewarre Complex (via the Moorabool and Barwon Rivers) (see Section 22.6). The potential indirect impacts on water flows and quality for these areas is discussed below.

Point Wilson / Limeburners Bay

Potential changes to water flows and quality at Point Wilson / Limeburners may impact vegetation and habitat for threatened fauna.

The area supports both seagrass and saltmarsh vegetation. Mapping of seagrass distribution has identified that the Point Wilson area contains a mix of medium and sparse *Zostera* spp. and the only significant patches of *Halophila ovalis* that occur within the area. Point Wilson also supports saltmarsh, although the extent is likely to have reduced since the time of listing (DELWP, 2020).

The area also supports a number of threatened fauna species. This includes estuarine and marine fish, breeding of *Sternula nereis* (Fairy Tern), and a number of migratory shorebirds. The area along the coast between Point Wilson and the Werribee River mouth is also considered to contain the most important sites for the Orange Bellied Parrot in Victoria (DELWP, 2020).

The potential influence on the hydrological values of the Point Wilson/Limeburners Bay area as a result of development within the NGGA is expected to be small given:

- The small area of the development (4.6per cent) relative to the size of the Hovells Creek catchment
- The greater apparent level of tidal versus freshwater influence of Limeburners Bay as indicated by the:
    - Relatively small size of Hovells Creek
    - Location and extent of mangroves along the banks of Limeburners Bay
    - Fact that decreased salinity and altered water regimes as a result of stormwater inflows are not identified as a threat to the Point Wilson/Limeburners Bay area of the Ramsar site
- The distance between the NGGA and Limeburners Bay (approximately 9-10 km)

The measures described below, which will lead to more detailed analysis, mitigation and management of these potential impacts, will ensure that any residual risks associated with stormwater and catchment inflows are adequately addressed.

Lake Connewarre Complex

The greatest risk in relation to stormwater and catchment inflows at the Ramsar site is at Lake Connewarre. The interaction between freshwater inflows and tidal exchange in the Lake Connewarre Complex is considered to be critical to the ecological character of the site. The Lake Connewarre Complex has a salinity gradient from fresher conditions at Reedy Lake to saline in the Barwon Estuary. The lake receives freshwater inflows from the Barwon river through Reedy Lake when flows overtop the boundary between the two wetlands. Fresh water flows are generally restricted to winter / spring when river discharge is the highest (DELWP, 2020). Changes to the salinity caused by increased stormwater and catchment inflows has the potential to impact the vegetation of the site, and habitat for native fish.

Increased toxicants in catchment inflows from the Moorabool and Barwon Rivers has the potential to impact vegetation and threatened fauna habitat within the Lake Connewarre Complex. The lake contains 68 per cent of the total saltmarsh within the broader site, while also supporting mangrove shrubland and freshwater wetland vegetation including lignum shrubland. Reedy Lake, the Barwon River Estuary and Lake Connewarre are important areas for native fish where over 20 species have been recorded. The Barwon river estuary is also an important migratory route for native fish. Lake Connewarre supports significant numbers of migratory shorebirds and Reedy Lake within the Lake Connewarre Complex is an important breeding site for colonial nesting (DELWP, 2020).

The potential influence on the interaction between freshwater inflows and tidal exchange in the Lake Connewarre Complex, and water quality indicators, as a result of development in the Growth Areas is expected to be small given:

- The distance between the two locations (around 41 km stream length)
- The effect of the Batesford Quarry in interrupting flows and connectivity

The measures described below, which will lead to more detailed analysis, mitigation and management of these potential impacts, will ensure that any residual risks associated with stormwater and catchment inflows are adequately addressed.

Commitments to address indirect impacts

The Plan includes a specific Commitment (Commitment 15) to minimise the indirect impacts of the development on protected matters associated with waterways, riparian areas and wetlands, including the ecological character of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. The measures relevant to water flow and quality that will be undertaken to deliver on this Commitment include:

- Undertaking relevant technical studies to understand the key risks from development on protected matters associated with Hovells Creek and the Moorabool River. These studies will be undertaken prior to PSP preparation for each relevant precinct and will:
    - Address potential risks associated with changes to water quality and hydrology as a result of development within the Growth Areas
    - Identify appropriate measures, standards or targets to avoid and minimise adverse impacts on protected matters including, as relevant:
        - Water quality parameters
        - Water retention and flow management requirements
        - Limits on extraction or use
        - Habitat buffer requirements
        - Monitoring and reporting
- Preparing guidelines based on the results of the relevant technical studies to guide the preparation of PSPs and decisions on planning permits and permit conditions to ensure risks to protected matters in relation to indirect and downstream impacts are adequately managed
- Undertaking a planning scheme amendment or other appropriate process to ensure guidelines are considered during preparation of PSPs and in decisions on planning permits and permit conditions

There are also a range of existing measures within the planning system that address changes to water flows and quality. The Geelong Planning Scheme includes requirements to:

- Ensure land use on floodplains minimises the risk of waterway contamination during flooding (Clause 13.03-1S)

- Prevent inappropriate development in areas prone to erosion (Clause 13.04-1S)
- Retain natural drainage corridors, minimise runoff volume from developed areas, filter sediment and waste from stormwater prior to discharge, ensure land use and development minimises nutrient contributions to runoff, and implement measures to minimise sediment discharge from construction sites (Clause 14.02-1S)
- Minimise impacts to water quality through ensuring that land uses which have potential to produce contaminated runoff are appropriately sited and managed (Clause 14.02-2S)
- Implement integrated water management to sustainably manage water supply and demand, water resources, wastewater, drainage, and stormwater (Clause 19.03-3S)

The Geelong Planning Scheme also includes a range of requirements to ensure stormwater management meets appropriate objectives and standards, including objectives for stormwater quality. The key measures are summarised in the BCS, Section 4.3, Table 12. For example, a key objective/standard is Clause 56.07-4, which says - an application for subdivision or development must meet stormwater objectives and standards, including objectives for stormwater quality in the *Urban Stormwater – Best Practice Environmental Management Guidelines* (Victorian Stormwater Committee, 1999).

The NWGGA Framework Plan also includes various mitigation-related actions to address water flows and quality, including implementation of riparian buffers, and the preparation of masterplans for Cowies Creek and Barwon and Moorabool rivers for integrated water management.

Commitment 13 of the Plan ensures that these standard mitigation measures will continue to be implemented over the life of the Plan. Refer to Section 5.5 of Chapter 5 for a more detailed description of these existing measures.

Implementation of Commitments 13 and 15 under the Plan will adequately minimise the risk of adverse impacts to the Ramsar site associated with changes to water flow and quality.

DISTURBANCE FROM INCREASED PUBLIC ACCESS TO NATURAL AREAS

Mechanism of impact

Development under the Plan will lead to increased numbers of people in the Greater Geelong region that may cause increased visitation to the Ramsar site. This has the potential to indirectly impact the Ramsar site through increased public access.

The following threats identified in the Ecological Character Description of the Ramsar site are relevant to this issue (DELWP, 2020):

- Litter (including micro-plastics) effects biota
- Boats, jets skis, kite surfers disturbing waterbirds
- Walkers, horse-riding disturbing waterbird feeding, breeding, and roosting
- Vehicles damaging saltmarsh
- Duck hunting impacts to non-target species

The Ramsar site is close to existing developed areas and is a popular destination for recreational activities. The recreational values of the site are also listed as a component of its Ecological Character (See Table 22-2) (DELWP, 2020).

This indirect impact is considered relevant to the three areas of the Ramsar site which occur within the Study Area.

Point Wilson / Limeburners Bay

Point Wilson / Limeburners is a designated public area managed by the City, Parks Victoria, and DELWP and occurs within the vicinity of significant urban development. The area includes Limeburners Lagoon State Nature Reserve which is managed by the City and Parks Victoria (DELWP, 2020).

The area is used recreationally for duck hunting during the season (March to June), small craft boating (such as canoes, kayaks, and small fishing boats), recreational fishing, walking, and horse riding. There are a number of visitor restrictions enforced by Parks Victoria intended to protect the biodiversity values of the area (DELWP, 2020).

While development under the Plan may increase visitation to Point Wilson / Limeburners Bay, it is considered unlikely that the increased visitation will significantly exacerbate the existing impacts of recreation on this section of the Ramsar site.

The Lake Connewarre Complex

The Lake Connewarre Complex is a designated public area managed by Parks Victoria and occurs within the vicinity of significant urban development. The majority of the area is managed as the Lake Connewarre State Game Reserve, with a small portion of land on the eastern and southern side of the lake managed as a Nature Conservation Reserve (DELWP, 2020).

The area is used recreationally for fishing (with a recreational fishing licence), small craft boating (such as canoes, kayaks, and small fishing boats) and duck hunting within designated areas during duck hunting season (March to June). There are a number of visitor restrictions enforced by Parks Victoria intended to protect the biodiversity values of the area (DELWP, 2020).

While development under the Plan may increase visitation to the Lake Connewarre Complex, it is considered unlikely that the increased visitation will significantly exacerbate the existing impacts of recreation on this section of the Ramsar site.

Werribee / Avalon

Werribee / Avalon is comprised of the Melbourne Water Western Treatment Plant, the Spit Wildlife Reserve, Werribee River Regional Park, Avalon Airfield, and a number of other private and publicly managed areas. The area is a designated public area and occurs between Melbourne and Geelong (DELWP, 2020).

The area is used recreationally for small craft boating (such as canoes, kayaks, and small fishing boats), walking, horse riding and duck hunting within designated areas during duck hunting season (March to June). Duck hunting is prohibited within two areas of Werribee / Avalon, the Spit Wildlife Reserve and the Western Treatment Plant, to protect priority locations for feeding shorebirds. There are a number of other visitor restrictions enforced by Parks Victoria in parts of Werribee / Avalon to protect the biodiversity values of the area (DELWP, 2020).

While development under the Plan may increase visitation to Werribee / Avalon, it is unlikely that the increased visitation will significantly exacerbate the existing impacts of recreation on this section of the Ramsar site.

Conclusion

Three areas of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site occur within the Study Area (Point Wilson / Limeburners Bay, Werribee / Avalon, and the Lake Connewarre Complex). These areas within the vicinity of highly urbanised locations and are subject to a range existing recreational pressure. The areas are currently managed by the City, Parks Victoria, and DEWLP, with a number of existing measures in place to protect the biodiversity of these areas. Although urban development in the Growth Areas may increase public use of the Ramsar site, it is unlikely that the threat will be significantly exacerbated by development under the Plan.

22.8 ADDRESSING OBLIGATIONS UNDER THE RAMSAR CONVENTION

To satisfy requirements under section 146J of the EPBC Act, section 4.6 of the ToR requires the Assessment Report to consider the extent to which the impacts of the Plan are consistent with Australia's international obligations, including the Ramsar Convention. The Ramsar Convention's broad aims are to halt the worldwide loss of wetlands and to conserve, through wise use and management, those that remain. This requires international cooperation, policy making, capacity building and technology transfer.

The Ramsar Convention has been considered in the development of the Plan, which includes consideration of avoidance, mitigation, and management measures for Ramsar wetlands. The Plan includes a specific commitment with a number of measures relevant to managing potential indirect impacts on the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site.

Impacts to the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site are unlikely and loss of wetlands due to the Plan is not foreseeable. The Plan is not considered to be inconsistent with the Ramsar Convention.

23 Non-threatened migratory species

23.1 INTRODUCTION

This chapter assesses potential impacts of implementing the Plan on non-threatened migratory species. Any species that are listed as both threatened and migratory are assessed in Chapter 19.

The chapter:

- Sets out the regulatory requirements relating to migratory species
- Identifies the species that are assessed
- Provides an assessment of the species that are migratory shorebirds
- Provides an assessment of the remaining species

23.2 REGULATORY REQUIREMENTS

23.2.1 EPBC ACT APPROVAL CONSIDERATIONS

Section 146L of the EPBC Act sets out the approval considerations in relation to migratory species. In summary, the outcomes of the Plan must not be inconsistent with any of the international agreements relating to migratory species. Of relevance to migratory birds are:

- The Bonn Convention (or the Convention on the Conservation of Migratory Species)
- The bilateral agreements for the conservation of migratory birds between the Government of Australia and the Government of Japan (JAMBA), the Government of China (CAMBA), and the Government of the Republic of Korea (ROKAMBA)

The *Wildlife Conservation Plan For Migratory Shorebirds* (Commonwealth of Australia, 2015) provides a useful summary of Australia's commitments under these agreements. The key obligations (of relevance to this assessment) which cut across the various agreements in different forms are for Australia to:

- Conserve and where possible restore habitats
- Mitigate and manage threats to migratory birds

It is also noted in the Wildlife Conservation Plan that the EPBC Act is the key piece of legislation which gives effect to Australia's international obligations. Following the process and meeting the requirements of the EPBC Act implicitly means that those obligations will be met.

23.2.2 RELEVANT GUIDELINES AND PLANS

EPBC ACT POLICY STATEMENT 3.21

There are 37 species of migratory shorebirds that are listed under the EPBC Act which regularly visit Australia during their non-breeding season. The *EPBC Act Policy Statement 3.21 - Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebirds* (the migratory shorebird guidelines) (DoE, 2017) provides guidance to assist proponents in avoiding, assessing and mitigating impacts to these migratory shorebirds.

These guidelines:

- Outline legislative obligations for the protection of migratory shorebirds
- Define important habitat and provide guidance for identifying important habitat
- Define an ecologically significant proportion of individuals for each species
- Define a significant impact on migratory shorebirds and provide guidance on the kinds of actions which can result in significant impacts
- Provide guidance on ways to avoid and/or mitigate impacts to migratory shorebirds

The information in these guidelines have been considered as part of this assessment.

Note that a detailed description of the definitions of important habitat and ecologically significant proportions of individuals for each species, and the way in which this information has been used in this assessment, is outlined in Chapter 12, Section 12.3.3.

WILDLIFE CONSERVATION PLAN FOR MIGRATORY SHOREBIRDS

The Wildlife Conservation Plan for Migratory Shorebirds (Commonwealth of Australia, 2015) provides a framework to guide the conservation of migratory shorebirds in Australia. It:

- Summarises Australia's commitments to migratory shorebirds under international conventions and agreements
- Outlines national actions to support shorebird conservation

The Wildlife Conservation Plan is consistent with the EPBC Act referral guidelines. Particularly in relation to the definition of important habitat and the discussion of threats.

WILDLIFE CONSERVATION PLAN FOR SEABIRDS

The *Wildlife Conservation Plan for Seabirds* (Commonwealth of Australia, 2020) aims to facilitate a nationally coordinated effort to protect and conserve seabirds listed under the EPBC Act. This plan has a series of objectives which relate to:

- Encouraging international collaboration to protect seabird habitats outside Australia
- Increasing identification and protection of seabird habitat within Australia
- Improving long-term survival of seabirds through research, monitoring, management and conservation activities
- Increasing community awareness of conserving seabirds and their habitats.

This seabird conservation plan includes profiles on seabird species, including ecology, habitat use, threats, and recommended management actions. The profiles are intended for use by agencies, land managers, and environmental organisations to inform management priorities for each species.

The information in this plan has been considered as part of this assessment.

23.3 IDENTIFICATION OF SPECIES REQUIRING ASSESSMENT

A categorisation process was completed to identify Category 1 non-threatened migratory species which have potential to be impacted under the Plan. This process involved consideration of:

- Guidance provided by the EPBC Act Significant Impact Guidelines 1.1 (DoE, 2013), draft referral guidelines (DoE, 2015a), and migratory shorebird guidelines (DoE, 2017) and supporting documents (Hansen, Fuller et al., 2016; Weller, Kidd et al., 2020)
- Information from key sources such as Birdlife International's Datazone database (Birdlife International, 2022) or other relevant information where available
- VBA records of species within the Study Area

Refer to Chapter 12 for a detailed description of the categorisation approach, and Chapter 18 for the categorisation results for non-threatened migratory species. Migratory species that are also listed as threatened are addressed in Chapter 19.

As a result of this categorisation process, three non-threatened migratory species were identified as Category 1 species requiring further assessment. They are all birds and include:

- Double-banded Plover (*Charadrius bicinctus*)
- Marsh Sandpiper (*Tringa stagnatilis*)
- Red-necked Stint (*Calidris ruficollis*)

All of these species are migratory shorebirds. Guidance for the assessment of these species is provided in the migratory shorebird guidelines (DoE, 2017), and these species have been assessed accordingly. The assessment of these three species is presented in Section 23.4 below.

23.4 .ASSESSMENT OF MIGRATORY SHOREBIRDS

23.4.1 BACKGROUND TO MIGRATORY SHOREBIRDS

Thirty-seven species of migratory shorebirds regularly visit Australia during their non-breeding season (from the Austral spring to autumn). The majority of those breed in the northern hemisphere and use the East Asian-Australasian Flyway which stretches from Siberia and Alaska, through east and south-east Asia, to Australia and New Zealand. They depend upon a range of sites along the flyway for breeding, staging, feeding, and roosting. In Australia, coastal and freshwater wetlands provide important habitat (Commonwealth of Australia, 2015).

23.4.2 OVERVIEW OF SPECIES BEING ASSESSED

Table 23-1 provides an overview of the records and important habitat for the three migratory shorebirds. Please refer to Map 23-1 for a map of the boundaries of Important Bird Areas (IBAs) identified in this table.

Note that the Werribee/Avalon IBA and the Lake Connewarre and Barwon River Estuary IBA are part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site, and the Moolap IBA is currently being considered for inclusion within the Ramsar site (Engage Victoria, 2022).

Table 23-1: Overview of Category 1 migratory shorebirds

Common name	Scientific name	Occurrence	Map	ESP* threshold	Location of important habitat^
Double-banded Plover	*Charadrius bicinctus*	There has been 1 record (4 individuals) of the Double-banded Plover within the Study Area over the past 5 years. These individuals are recorded to occur in the Werribee/Avalon IBA, to the west of Lake Borrie. This is below the threshold of an ecologically significant proportion of records for the species. While few individuals of the Double-banded Plover have been recorded within the last 5 years, it is noted that when historical records are considered, a substantial number of individuals has been recorded within the Study Area within recent years (7,998 individuals from 1990 onwards). These records occur: • Along the northern shoreline of Port Phillip Bay. A small number of records also occur in the vicinity of Limeburners Bay. This area is part of the Werribee/Avalon IBA • Within the Lake Connewarre Complex. This area is part of the Lake Connewarre and Barwon River Estuary IBA • In the Moolap locality. This area is part of the Moolap IBA	Map 23-2 and Map 23-3	19 individuals within the last 5 years (DoE, 2017; Hansen, Fuller et al., 2016).	Important habitat for the Double-banded Plover has been mapped by Birdlife Australia within the Study Area in the following localities (Weller, Kidd et al., 2020): • Lake Connewarre and Barwon River Estuary IBA • Werribee/Avalon IBA • Moolap IBA
Marsh Sandpiper	*Tringa stagnatilis*	There has been 1 record (1 individual) of the Marsh Sandpiper within the Study Area over the past 5 years. This is below the threshold of an ecologically significant proportion of records for the species. While few individuals of the Marsh Sandpiper have been recorded within the last 5 years, it is noted that when historical records are considered, a substantial number of individuals has been recorded within the Study Area within recent years (10,296 individuals from 1990 onwards). Most of these individuals (over 4,000) occur along the coastline of Port Phillip Bay, extending from Avalon Beach in the west to the boundary of the Study Area in the east. This area is part of the Werribee/Avalon IBA. A substantial proportion of individuals (over 200) also occur within the Lake Connewarre Complex. This area is part of the Lake Connewarre and Barwon River Estuary IBA. Individuals are also recorded to occur within the Moolap region. This area is part of the Moolap IBA.	Map 23-4	130 individuals within the last 5 years (DoE, 2017; Hansen, Fuller et al., 2016).	Important habitat for the Marsh Sandpiper has been mapped by Birdlife Australia within the Study Area in the following localities (Weller, Kidd et al., 2020): • Werribee/Avalon IBA • Moolap IBA

Common name	Scientific name	Occurrence	Map	ESP* threshold	Location of important habitat^
Red-necked Stint	*Calidris ruficollis*	There have been 24 records (3,875 individuals) of the Red-necked Stint within the Study Area over the past 5 years. This is above the threshold of an ecologically significant proportion of records for the species. A majority of these recent individuals occur along the coastline of Port Phillip Bay, between The Spit Wildlife Reserve and Lake Borrie, part of the Werribee/Avalon IBA. Some recent individuals were also recorded in the Moolap locality (part of the Moolap IBA). While there are no records in these localities within the last 5 years, when date filters are removed and all available records of the species are considered, substantial records of the species occur within the Lake Connewarre Complex (part of the Lake Connewarre and Barwon River Estuary IBA).	Map 23-5	475 individuals within the last 5 years (DoE, 2017; Hansen, Fuller et al., 2016).	Important habitat for the Red-necked Stint has been mapped by Birdlife Australia within the Study Area in the following localities (Weller, Kidd et al., 2020): • Lake Connewarre and Barwon River Estuary IBA • Werribee/Avalon IBA • Moolap IBA

*ESP – Ecologically Significant Proportion

^ Refer to Map 23-1 for a map of important habitat

23.4.3 APPROACH TO ASSESSMENT

GUIDANCE WHICH INFORMED ASSESSMENT APPROACH

Impact pathways

The migratory shorebird guidelines set out four pathways by which impacts can be significant to migratory shorebirds:

- Loss of important habitat
- Degradation of important habitat leading to a substantial reduction in migratory shorebird numbers
- Increased disturbance within important habitat leading to a substantial reduction in migratory shorebird numbers
- Direct mortality of birds leading to a substantial reduction in migratory shorebird numbers

Avoiding and/or mitigating impacts

The migratory shorebird guidelines also outline a set of general measures to avoid and/or mitigate impacts to shorebirds. Measures include:

- Making every effort to avoid habitat loss
- Ensuring habitat is not degraded through the introduction of exotic species; changes to hydrology or water quality (including toxic inflows); fragmentation of habitat or exposure to litter or pollutants; and exposure of acid sulphate soils
- Mitigating against the impacts of disturbance
- Considerations around direct mortality to shorebirds
- Consideration of climate change

APPROACH TO ANALYSING IMPACTS

This assessment primarily draws on the concepts presented in the migratory shorebird guidelines and is based on:

- Analysis of potential direct and indirect impacts with a focus on:
  - The four potential impact pathways set out in the guidelines
  - The general measures to avoid and/or mitigate impacts to shorebirds set out in the guidelines
- Consideration of regulatory requirements for migratory species

The potential loss of important habitat was calculated by:

- Considering the locations of mapped important habitat for each of the shorebird species with regards to areas of development under the Plan
- Considering potential changes to hydrology, water quality or vegetation structural changes near important habitat sites

Potential degradation and disturbance within important habitat, and potential direct mortality of migratory shorebirds were assessed through:

1. Identifying how the Plan that may lead to these impacts
2. Considering how those activities are proposed to be managed under the Plan
3. Analysing the residual risk to important habitat and shorebirds

APPROACH TO EPBC ACT APPROVAL CONSIDERATIONS

Regulatory requirements were considered at the end of the assessment by drawing together the results of the impact analysis, examination of the benefits of the conservation measures in the Plan and reviewing any specific requirements for migratory species.

23.4.4 IMPACT ANALYSIS

This section considers the potential impacts to migratory shorebirds against the four impact pathways identified in the migratory shorebird guidelines (DoE, 2017). It also provides a brief consideration of climate change and an evaluation of the outcomes for shorebirds as listed migratory species.

LOSS OF IMPORTANT HABITAT

As outlined in the migratory shorebird guidelines (DoE, 2017), loss of important habitat can occur through either:

- Direct loss: e.g., through clearing, inundation, infilling or draining
- Indirect loss: e.g., through changes to hydrology, water quality, or vegetation structural changes near roosting areas

Direct loss

There will be no direct loss of important habitat due to development under the Plan. No important habitat is located within, or immediately adjacent to, the Strategic Assessment Area.

Important habitat for migratory shorebirds in the Study Area is located as follows (Weller, Kidd et al., 2020):

- Lake Connewarre and Barwon River Estuary IBA – this IBA is located over 7 km south-south-east of the Strategic Assessment Area
- Werribee/Avalon IBA – this IBA is located approximately 2 km to the east of the Strategic Assessment Area
- Moolap IBA – this IBA is located over 5 km east-south-east of the Strategic Assessment Area

Indirect loss

Changes to hydrology and water quality

Urban development and transport have the potential to lead to changes to hydrology and water quality. This is related to a range of factors but includes:

- Potential disruption to natural water flows
- The increase of hard surfaces leading to increased runoff
- Potential introduction of a range of contaminants that may affect water quality (e.g., nutrients, chemicals)

Migratory shorebird habitat that would be at risk of these effects are sites that are:

- In close proximity to development areas
- Hydrologically well connected (e.g., downstream) to development areas

None of the identified IBAs are in close proximity to development areas. However, some of the IBAs are downstream of development areas.

Of the identified IBAs, the following areas are downstream of development under the Plan:

- Lake Connewarre and Barwon River Estuary IBA is downstream of the WGGA via the Moorabool River, which discharges into the Barwon River. Approximately 39 per cent of the WGGA, and a small proportion of the NGGA (~2 per cent), drains into the Moorabool River (The City of Greater Geelong, 2016)
- Werribee/Avalon IBA is partially downstream of the Strategic Assessment Area. The westernmost section of this IBA, Limeburners Bay, is part of the Hovells Creek catchment. Approximately 52 per cent of the NGGA will drain to the Hovells Creek Catchment (The City of Greater Geelong, 2016). Other areas of this IBA, however, are not hydrologically linked to the Strategic Assessment Area

The Moolap IBA is not downstream of the Strategic Assessment Area.

The Plan includes a specific Commitment (Commitment 15) to minimise the indirect impacts of the development on protected matters associated with waterways, riparian areas and wetlands, including EPBC listed threatened and migratory birds. The measures relevant to changes to hydrology and water quality that will be undertaken to deliver on this Commitment include:

- Undertaking relevant technical studies to understand the key risks from development on protected matters associated with Hovells Creek and the Moorabool River. These studies will:
    - Address potential risks associated with changes to water quality and hydrology as a result of development within the Growth Areas
    - Identify appropriate measures, standards or targets to avoid and minimise adverse impacts on protected matters including, as relevant:
        - Water quality parameters
        - Water retention and flow management requirements
        - Limits on extraction or use
        - Habitat buffer requirements
        - Monitoring and reporting
- Preparing guidelines based on the results of the relevant technical studies to guide the preparation of PSPs and decisions on planning permits and permit conditions to ensure risks to protected matters in relation to indirect and downstream impacts are adequately managed
- Undertaking a planning scheme amendment or other appropriate process to ensure guidelines are considered during preparation of PSPs and in decisions on planning permits and permit conditions

There are also a range of existing measures within the planning system that address changes to hydrology and water quality. The Geelong Planning Scheme includes requirements to:

- Ensure land use on floodplains minimises the risk of waterway contamination during flooding (Clause 13.03-1S)
- Prevent inappropriate development in areas prone to erosion (Clause 13.04-1S)
- Retain natural drainage corridors, minimise runoff volume from developed areas, filter sediment and waste from stormwater prior to discharge, ensure land use and development minimises nutrient contributions to runoff, and implement measures to minimise sediment discharge from construction sites (Clause 14.02-1S)
- Minimise impacts to water quality through ensuring that land uses which have potential to produce contaminated runoff are appropriately sited and managed (Clause 14.02-2S)
- Implement integrated water management to sustainably manage water supply and demand, water resources, wastewater, drainage, and stormwater (Clause 19.03-3S)

The Geelong Planning Scheme also includes a range of requirements to ensure stormwater management meets appropriate objectives and standards, including objectives for stormwater quality (for example, see Clause 53.18).

The NWGGA Framework Plan also includes various mitigation-related actions to address changes to hydrology and water quality, including implementation of riparian buffers, and the preparation of masterplans for Cowies Creek and Barwon and Moorabool rivers for integrated water management.

Commitment 13 of the Plan ensures that these standard mitigation measures will continue to be implemented over the life of the Plan. Refer to Section 5.5 of Chapter 5 for a more detailed description of these existing measures.

Implementation of Commitments 13 and 15 under the Plan will adequately minimise the risk of adverse impacts associated with changes to hydrology and water quality

Changes to vegetation structure

Changes to vegetation structure can arise from factors such as increased vegetation cover or encroachment of buildings (DoE, 2017). This may be possible at sites that are in close proximity to development.

As outlined above, no areas of important habitat are located close to areas of development under the Plan. Subsequently, the Plan will not contribute to this threat in areas of important habitat in the Study Area.

DEGRADATION OF IMPORTANT HABITAT LEADING TO A SUBSTANTIAL REDUCTION IN MIGRATORY SHOREBIRD NUMBERS

The migratory shorebird guidelines (DoE, 2017) set out examples of the types of activities that can lead to degradation of important habitat. They include:

- Activities occurring in coastal or estuarine environments. For example:
  - Substantial loss of marine or estuarine vegetation
  - Invasion of intertidal mudflats by weeds
  - Exposure of acid sulfate soils
- Water pollution and changes to the water regime

Activities in coastal or estuarine environments

The Strategic Assessment Area is mostly comprised of agricultural areas and grassland habitats, and mostly does not include estuarine or coastal environments. The only coastal/estuarine environment is within the south-eastern arm of the Strategic Assessment Area, which extends along Cowies Creek to the edge of Corio Bay. This area is subject to existing development, and no new development will occur here under the Plan. Development under the Plan will instead occur further inland and will be concentrated within the two Growth Areas.

As development under the Plan will not occur in coastal or estuarine environments, the Plan will not result in substantial loss of marine or estuarine vegetation, and further will not result in invasion of intertidal mudflats by weeds.

Further, the location of coastal acid sulfate soils within Geelong have been mapped. The Strategic Assessment Area does not contain any coastal acid sulfate soils (Department of Jobs Precincts and Regions, 2022). Development under the Plan will not result in exposure of acid sulfate soils.

Water pollution and changes to the water regime

Potential water pollution and changes to the water regime are similar issues to those discussed above in relation to hydrology and water quality.

As outlined above, implementation of Commitments 13 and 15 under the Plan will adequately minimise the risk of adverse impacts associated with changes to hydrology and water quality

INCREASED DISTURBANCE WITHIN IMPORTANT HABITAT LEADING TO A SUBSTANTIAL REDUCTION IN MIGRATORY SHOREBIRD NUMBERS

As outlined in the migratory shorebird guidelines (DoE, 2017) increased disturbance to migratory shorebirds is a key threat within Australia. It may occur through:

- Construction activities (e.g., demolition)
- Residential and recreational activities such as four-wheel-driving, jet- and water-skiing, power boating, fishing, walking, windsurfing, kite-surfing, walking dogs, noise, and night-lighting

Migratory shorebird habitat that would be at risk of these effects are sites that are:

- In close proximity to development areas
- Publicly accessible for recreation (particularly where this is not managed to protect shorebirds)
- Adjacent to recreation areas (e.g., waterways used for boating etc)

The Plan has potential to increase the risk of disturbance to shorebird habitat from increased public access to natural areas through increasing the population size of the Geelong region. However, it is also recognised that the Geelong region is already substantially developed, with an existing large population size, in addition to a large number of visitors to the region. Therefore, disturbance of natural areas from public access is considered an existing threat in the region. It is unlikely that the Plan would substantially exacerbate this threat beyond its current levels in the region.

There are a range of existing measures in place to manage human disturbance to important shorebird habitat. The Lake Connewarre and Barwon River Estuary IBA and the Werribee/Avalon IBA both have existing wildlife reserves in key areas of habitat within these IBAs. These reserves are managed by Parks Victoria to protect and enhance flora and fauna values while supporting appropriate community use. Refer to Table 23-2 for further information on the characteristics of each reserve, existing management measures in place, and for a list of the migratory shorebird species which have important habitat within the reserve.

Further, while the Moolap IBA does not have a reserve in place, the site is managed under the Moolap Coastal Strategic Framework Plan. Refer to Table 23-2 for further information on the characteristics of this area, existing management measures in place, and for a list of the migratory shorebird species which have important habitat at this site.

Overall, it is considered that the existing management measures of each of the areas of important habitat will adequately minimise the risk of adverse impacts associated with disturbance of important shorebird habitat.

Table 23-2: Existing management of important shorebird habitat within the Study Area

IBA	Habitat supported by the IBA	Managed areas within IBA	Location and description	Existing management
Lake Connewarre and Barwon River Estuary IBA	Double-banded Plover; Red-necked Stint	Lake Connewarre Wildlife Reserve	This reserve is located within the Lake Connewarre Complex and is part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. It is a large, shallow estuarine lagoon, and contains a diverse range of wetlands and vegetation including mangroves and saltmarsh communities.	This reserve is managed by Parks Victoria. The reserve is large and has variable restrictions in different areas of the reserve. Dogs are permitted on a leash in some locations and are prohibited in other areas. The following are prohibited in some areas, yet permitted in other areas: horses, vehicles (excluding management vehicles), firearms, camping, and generators. Fires are prohibited and boating zones apply throughout the reserve. (Parks Victoria, 2022a, 2022d, 2022e)
Werribee/ Avalon IBA	Double-banded Plover; Marsh Sandpiper; Red-necked Stint	Limeburners Lagoon Flora and Fauna Reserve	This reserve is located within Limeburners Bay and is part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. It is part of a broad, sandy estuarine inlet, with shallow tidal water. The inlet supports shoreline, sandy spit and seagrass environments.	This reserve is managed by Parks Victoria. The following are not permitted: dogs, cats, other pets, horses, bicycles, fires, firearms, and vehicles (excluding management vehicles). (Parks Victoria, 2022c)
		The Spit Wildlife Reserve	This reserve is located within the Point Wilson area and is part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. It contains sand spits, a lagoon, mudflats and areas of saltmarsh.	This reserve is managed by Parks Victoria. Public access to this reserve is partially restricted. At publicly accessible sites, dogs and vehicles (excluding management vehicles) are prohibited. Boating zones also apply (Parks Victoria, 2022h). Public access to some areas of the reserve is restricted and require a permit from Melbourne Water as the site is adjacent to the Werribee Sewage Farm (Conservation Volunteers Australia, 2022).
Moolap IBA	Double-banded Plover; Marsh Sandpiper; Red-necked Stint	'Wetlands and Former Saltworks Precinct' within the Moolap	The Moolap Coastal Strategic Plan outlines the management objectives and strategies for the Moolap area. The area covered by the Strategic	The overarching goal for the Precinct is that the area be managed and coordinated to prioritise environmental outcomes and to respond to existing values and risks.

IBA	Habitat supported by the IBA	Managed areas within IBA	Location and description	Existing management
		Coastal Strategic Framework Plan	Plan includes the Moolap IBA, in addition to areas of land outside of the IBA. The majority of the Moolap IBA is located in the 'Wetlands and Former Saltworks Precinct' of the Strategic Plan. The area includes salt pans separated by bunds (from a former saltworks) which is used as a feeding location by many migratory birds. Seagrass meadows occur in the shallow bay area adjacent to the salt bunds.	With regards to disturbance management, the Strategic Plan contains a range of strategies, including: • Facilitating while managing public access to enable recreation and passive enjoyment of the area while conserving environmental values • Avoiding and managing risks of domestic animals entering conservation areas • Avoiding boating and marine infrastructure where it would impact ecological values (DELWP, 2019)

DIRECT MORTALITY OF BIRDS LEADING TO A SUBSTANTIAL REDUCTION IN MIGRATORY SHOREBIRD NUMBERS

As outlined in the migratory shorebird guidelines (DoE, 2017), direct mortality of birds may result from activities relating to:

- Bird strike due to:
  - Development of wind farms in migration or movement pathways
  - Aeroplanes or fixed structures such as towers with support cables
- Inappropriate waste management and chemical or oils spills

Bird strike

Development under the Plan does not relate to windfarms, aeroplanes, or large fixed structures with support cables. Risks of significant bird strike due to the development are considered to be low.

Inappropriate waste management and chemical or oils spills

Potential impacts due to inappropriate waste management and chemical or oils spills are similar issues to those discussed above in relation to hydrology and water quality.

As outlined above, implementation of Commitments 13 and 15 under the Plan will adequately minimise the risk of adverse impacts associated with changes to hydrology and water quality.

CONSIDERATION OF CLIMATE CHANGE

The migratory shorebird guidelines (DoE, 2017) suggest that "areas landward of important shorebird habitat areas should be maintained in an undeveloped state to allow the natural coastal processes of erosion and accretion to respond to possible rising sea levels".

The Strategic Assessment Area is not located in proximity to important shorebird habitat within the Study Area, nor is it located landward of any area of important bird habitat. Subsequently, development under the Plan will not exacerbate potential issues at important bird areas associated with rising sea levels.

Section 29.5 of Chapter 29 describes how the Plan more broadly has considered the extent to which it facilitates adaptation to climate change for MNES, including consideration of any particularly vulnerable matters.

EVALUATION OF THE OUTCOME FOR MIGRATORY SHOREBIRDS

As outlined in Section 23.2, the outcomes of the Plan must not be inconsistent with any of the international agreements relating to migratory species. The key obligations (of relevance to this assessment) which cut across the various agreements in different forms are for Australia to:

- Conserve and where possible restore habitats
- Mitigate and manage threats to shorebirds

The Plan is not inconsistent with these obligations, as:

- There will be no direct impacts to important habitat
- Indirect impacts to important habitat will be adequately controlled through commitments under the Plan and through existing land management frameworks in the region

23.4.5 CONCLUSION

The Plan will not result in residual adverse impacts to migratory shorebirds. No important habitat will be lost, and potential indirect impacts will be suitably mitigated and managed.

The outcomes of the Plan for these species meets the regulatory requirements for listed migratory species under the EPBC Act.

.

24 Finalised Priority Assessment List (FPAL)

This chapter considers the potential impacts of the Plan on species and ecological communities that are identified on the Finalised Priority Assessment List (FPAL) (DCCEEW, 2024d) to be listed as threatened in the future.

One FPAL species has been identified as a Category 1 species requiring detailed assessment. This species is *Galaxiella toourtkoourt* (Little Galaxias). The species was previously known as *Galaxiella pusilla,* though has been formally re-described as two species, *Galaxiella toourtkoourt* and *Galaxiella pusilla* (Coleman, Hoffman and Raaik, 2015). Prior to taxonomic revision, both species were listed as Vulnerable as *Galaxiella pusilla*. Due to the recent taxonomic revision, and pending listing of *G. toourtkoourt*, it is appropriate to assess this species as a threatened species. *G. toourtkoourt* is assessed in Chapter 19.

25 Cumulative impact assessment

25.1 INTRODUCTION

The Strategic Assessment Area is located within the Southern Volcanic Plain bioregion. This bioregion has a history of cumulative vegetation clearance and degradation. Historically, large areas of grasslands and woodland in the bioregion, including the Strategic Assessment Area, were cleared or degraded through agricultural land use (DSE, 2003; EHP, 2021). More recently, agricultural land is increasingly being developed as urban and commercial districts associated with regional growth in areas close to Melbourne, including Geelong. Native vegetation in the bioregion is becoming increasingly restricted, mostly occurring within reserves without formal conservation and within riparian corridors. Native vegetation that remains on agricultural land is typically highly modified and degraded, providing low biodiversity value (EHP, 2021).

Development of land within the bioregion is expected to continue in the coming decades. Geelong is considered to be the primary population centre outside of Melbourne and the population is forecast to increase from 317,857 people to over 500,000 by 2050 (Victoria State Government, 2017; The City of Greater Geelong, 2021b). Geelong will therefore be a key area for urban and commercial development within the bioregion.

In order to support the projected growth of Geelong, significant areas of land are required for development including housing, employment, community spaces and transport. The proposed development of land within the Strategic Assessment Area under the Plan will facilitate substantial social and economic growth. The Plan also recognises the importance of the unique environmental values within Geelong and the wider bioregion and will facilitate Geelong's future transformation by delivering diverse and sustainable urban development, within a landscape of protected areas for biodiversity conservation.

Through accommodating long-term population growth in a planned and strategic way, the Plan reduces the potential for adverse cumulative impacts to occur within the region. The Plan also includes a number of commitments to increase protection of the region's valuable environmental assets, which further reduces the risk of adverse cumulative impacts.

Although the Plan reduces the risk of cumulative impacts in the region over the long term, there is still a potential for adverse cumulative impacts to occur due to the combined impact of the Plan with other developments in the region. This Chapter provides an assessment of the cumulative impacts to MNES which may occur due to the combined effect of development under the Plan and other developments in the region.

25.2 REQUIREMENTS AND PURPOSE OF THE CIA

The Terms of Reference (ToR) for the strategic assessment require the following for cumulative impact assessment (CIA):

> *3.2 The Report must identify and describe each protected matter that may be impacted directly, indirectly and/or cumulatively by actions proposed to be taken under the Plan (the 'relevant protected matters')…*
>
> *4.1 The Report must describe and assess the likely direct, indirect and cumulative impacts of actions taken under the Plan on all relevant protected matters. This must include, but not necessarily be limited to, an assessment of impacts of clearing, disturbance and fragmentation.*

The protected matters that may be subject to direct, indirect and/or cumulative impacts by actions proposed to be taken under the Plan (relevant protected matters) are identified in Chapter 18. Each relevant protected matter has been subject to a matter-specific impact assessment (see Chapters 19 – 24). This Chapter assesses the cumulative impacts of actions taken under the Plan on MNES in the Strategic Assessment Area and wider region.

The purpose of the CIA is to:

- Understand cumulative impacts and threatening processes to MNES in the region
- Understand how development under the Plan may contribute to or exacerbate these threatening processes
- Evaluate the adequacy of the Plan's proposed avoidance, mitigation, and offset commitments in relation to the threatening processes

25.3 OVERVIEW AND STRUCTURE

The CIA approach involved the following key components:

- An understanding of the potential cumulative impacts and key threatening processes for relevant protected matters
- A quantitative assessment of cumulative direct impacts of the actions taken under the Plan and other projects in the Study Area on relevant protected matters
- A qualitative assessment of cumulative impacts to relevant protected matters in the region which considers potential direct impacts of smaller-scale developments, in addition to potential indirect impacts associated with development more broadly
- An evaluation of the adequacy of the Plan's proposed avoidance, mitigation, and offset commitments in relation to cumulative impacts for relevant protected matters

The Chapter is structured as follows:

- The cumulative impacts and threatening processes within the Study Area are identified
- Relevant protected matters for each assessment (quantitative and qualitative) are identified
- The quantitative impact assessment is presented, which includes an evaluation of impacts to relevant protected matters
- The qualitative impact assessment is presented, which includes an evaluation of the Plan's proposed avoidance, mitigation, and offset commitments in relation to the relevant threats and pressures

25.4 CUMULATIVE IMPACTS AND THREATENING PROCESSES

25.4.1 CUMULATIVE IMPACTS

The direct and indirect impacts that may occur as a result of actions taken under the Plan are identified and described in Chapter 11. Direct impacts include direct damage to species or TECs, or their habitat, within the development land as a result of land clearing for development. Development under the Plan also has the potential to indirectly impact habitat and populations of MNES within the Growth Areas and the wider region. These indirect impacts relate to:

- Changes to water flows and water quality
- Spread of infection or disease
- Spread of weeds
- Predation or competition by pest or domestic fauna
- Altered fire regimes
- Disturbance from increased public access to natural areas
- Fauna mortality and barriers to movement
- Disturbance due to noise, dust, or light
- Inadvertent impacts on adjacent habitat or vegetation

The direct and indirect impacts identified for Plan have the potential to have a cumulative effect on MNES in the Strategic Assessment Area and surrounding area, whereby the cumulative impacts from development under the Plan and other developments in the region result in combined effects that may be greater than the impact of an individual activity.

25.4.2 CUMULATIVE THREATING PROCESSES

The impacts identified under the Plan have also been considered with regards to Key Threatening Processes (KTPs) identified under the EPBC Act. The impacts identified and their cumulative effect have the potential exacerbate existing threating processes to MNES present within the Strategic Assessment Area and the surrounding region. The KTPs relevant to the Plan are identified in Chapter 17 and include:

- Land clearance
- Competition and land degradation by rabbits
- Competition and land degradation by unmanaged goats

- Fire regimes that cause declines in biodiversity
- Infection of amphibians with chytrid fungus resulting in chytridiomycosis
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants
- Novel biota and their impact on biodiversity
- Predation by feral cats
- Predation by European red fox
- Predation, habitat degradation, competition and disease transmission by feral pigs

25.5 MNES SUBJECT TO THE CIA

Relevant protected matters are the protected matters that may be impacted directly, indirectly and/or cumulatively by actions proposed to be taken under the Plan (as defined in the Strategic Assessment Agreement). Chapter 18 of the SAR identifies relevant protected matters for the strategic assessment as the following:

- One threatened ecological community
- 24 threatened species
- One species on the Finalised Priority Assessment List (FPAL)
- Three migratory species not listed as threatened
- One Ramsar site

25.5.1 QUANTITATIVE ASSESSMENT

A quantitative CIA was undertaken for MNES that will be subject to direct impacts under the Plan and other projects in the Study Area (see Section 25.6). Only direct impacts to mapped habitat are able to be accurately quantified and therefore this assessment was limited to relevant protected matters with quantifiable direct impacts as a result of actions taken under the Plan. This includes:

- Natural Temperate Grassland of the Victorian Volcanic Plain TEC
- Striped Legless Lizard
- Golden Sun Moth
- Victorian Grassland Earless Dragon

Blue-winged Parrot was excluded from the quantitative CIA as impacts to potential habitat were not quantified as part of the impact assessment. No residual impacts to Blue-winged Parrot are expected as a result of development under the Plan (see Chapter 19.4).

The quantitative CIA was undertaken based on habitat rather than impacts to records or populations because habitat was most widely available information to enable comparison between the Plan and across the other projects. In the case of Victorian Grassland Earless Dragon, habitat for the potential recovery of the species was used (as used in the species impact assessment, see Section 19.5)

All other relevant protected matters, including Blue-winged Parrot, were only subject to the qualitative CIA (see below).

It is noted that the quantitative impact assessment includes potential direct impacts to modelled habitat within the portion of Heales Road East subject to process based development in the NGGA. There is uncertainty around the location and / or extent of impacts of development in this area. To be precautionary, the maximum potential direct impact to MNES in this area based on modelled habitat has been included in the quantitative assessment. See Section 8.6 of Part 2 for further details on Heales Road East process based development.

25.5.2 QUALITATIVE ASSESSMENT

The qualitative CIA was undertaken for all impacts of the Plan and other projects or actions in the region (see Section 25.7). This included direct impacts that could not be accurately quantified and indirect impacts. All relevant protected matters were considered in the qualitative CIA. However, this assessment was based around cumulative exacerbation of direct and indirect impacts relevant to the Plan, not through a CIA for each individual protected matter.

25.6 QUANTITATIVE CIA

25.6.1 PURPOSE OF THE QUANTITATIVE CIA

The purpose of the quantitative cumulative impact assessment is to evaluate cumulative impacts to relevant protected matters directly impacted under the Plan that are also directly impacted by other projects in the Southern Volcanic Plain bioregion by:

- Assessing the significance of cumulative impacts across the Plan and the other projects on these matters
- Determining whether the commitments under the Plan to address direct impacts to each matter are adequate in the context of the cumulative impacts on those matters

25.6.2 IDENTIFICATION OF OTHER PROJECTS

The assessment considers impacts from other projects in the Study Area:

- That have disturbance footprints which are outside (or partly outside) of the development land within the Growth Areas, as any development within this land is addressed by the Plan's impact assessment
- That have quantifiable impact footprints
- That will directly impact threatened ecological communities, species populations and/or species habitat that are also directly impacted by development under the Plan
- Where clearing for development has not yet occurred or has only occurred over part of the project area to date

Table 25-1 identifies the other projects included in the cumulative impact assessment and data availability for each project. The location of each project is shown in Map 25-1.

The Study Area was used as the boundary or scale for undertaking the quantitative CIA. This scale is considered appropriate for the quantitative CIA because:

- It provides a clearly defined area for cumulative impact assessment which is extends into the wider region
- Allows cumulative assessment for MNES that are in the same bioregion and locality as the Growth Areas and are therefore subject to similar cumulative pressures and threats
- Has an appropriate level of data availability to undertake a quantitative assessment

Note that the Strategic Assessment Area includes the entire NGGA as described in the Framework Plan but only includes the northern portion of the WGGA (the Creamery Road and Batesford North precincts). The remaining section of the WGGA identified in the Framework Plan covers 2,472.3 ha and has been excluded from the strategic assessment due to a lack of information and resolution relating to a range of factors needed to support and rationalise a full assessment and approval under the EPBC Act. This includes the anticipated development demand and timing, and the detailed plans for decommission and rehabilitation of the active quarry.

Although the southern portion of the WGGA was excluded from the Strategic Assessment Area and has not been submitted for approval, it is included within this cumulative impact assessment. This is because development of the area for urban growth is identified within the State planning framework and is therefore likely to be undertaken and contribute to cumulative impacts to MNES in the region.

The data available for the WGGA is limited compared to the other quantifiable projects as the development areas have not yet been surveyed and finalised, and offsets have not yet been identified. For the purposes of the CIA, the direct impacts from development of the southern WGGA are based on the layout of development land identified in the Framework Plan. This is therefore a conservative approach as the area will be subject to a further avoidance process to identify land avoided and/or protected for conservation purposes.

25.6.3 IDENTIFICATION OF AT RISK MATTERS

The relevant protected matters that are most likely at risk from cumulative impacts are those matters where:

- The Plan is having a notable impact (it is not within the scope of the Plan to address cumulative impacts from other projects on species/TECs that are subject to negligible or minor impacts under the Plan), AND

- The other projects make a significant contribution to cumulative impacts (relevant protected matters not substantially impacted by other projects only need to be addressed in terms of the impacts of the Plan). This was considered to be where:
    - Other projects have a total impact greater than 100 per cent of the impact of the Plan, or
    - Other projects have a total impact greater than 2 per cent of remaining habitat within the Study Area, AND
- There is a significant total cumulative impact from the Plan and major projects – this was considered to be where cumulative impacts were greater than 5 per cent of remaining habitat within the Study Area

25.6.4 LIMITATIONS

The quantitative CIA has the following limitations:

- Only known projects with publicly available information could be included (either through EPBC referral or state planning)
- Detailed data in relation to impacts was not always available for each project
- Impacts to potential Victorian Grassland Earless Dragon habitat from other projects have historically not been assessed as prior to 2023 it was considered extinct
- Projects included in the CIA have not yet determined offset liability and/or secured offsets
- Data was not always available in a form that allowed consistent comparison across major projects or the Plan. For example, the Plan assesses species habitat in terms of known habitat from a combination of surveys, records and modelling (refer to Chapter 13 of Part 3) and potential habitat, whereas some major projects assess species habitat in terms of known or likely habitat (as these assessments are done at a finer scale) or a combination of both
- Due to data availability, cumulative impacts were not considered in terms of indirect impacts. Refer to Section 25.7 for evaluation of indirect impacts associated with cumulative impacts more broadly

Table 25-1: Other projects included in the quantitative cumulative impact assessment and data availability

Project *	Comments	Data source	Data used in the cumulative impact assessment			
			Impact data		Offset data	
			TEC	Species habitat	TEC	Species habitat
Southern WGGA	Clearing for urban development of the southern portion of the WGGA (excluded from the Strategic Assessment Area). Data used to calculate direct impact extent included the development land identified in the Framework Plan. This is likely an over estimation compared to actual direct impact that will occur.	*Northern and Western Geelong Growth Area Framework Plan* (The City of Greater Geelong, 2021b)	Modelled potential extent within development land	Modelled potential habitat extent within development land	Data not available	Data not available
Barwon Solar Farm (2023/09703)	Clearing to facilitate construction and operation of a solar farm and battery energy storage system (BESS) on Little River-Ripley Road, Victoria.	*Barwon Solar Farm: Flora and fauna assessment* (Biosis, 2023)	Known extent within project area based on on-ground surveys conducted in 2022	Known and potential habitat within project area based on on-ground surveys conducted in 2022	Data not available	Data not available
Vopak Victoria Energy Terminal (2023/09507)	Clearing and construction to build and operate a floating Liquefied Natural Gas (LNG) import terminal in Port Phillip Bay including onshore gas pipeline, transmission station and overhead powerline.	*Vopak Victoria Energy Terminal Terrestrial Flora and Fauna Assessment* (Aurecon, 2022)	Modelled potential extent within development land	Modelled potential extent within development land	Data not available	Data not available

Project *	Comments	Data source	Data used in the cumulative impact assessment			
			Impact data		Offset data	
			TEC	Species habitat	TEC	Species habitat
Parwan-Balliang Irrigation District (PBID) - Foundation Recycled Water Irrigation Areas (Stage 1) (2023/09564)	Clearing to facilitate construction of on-farm irrigation infrastructure including pipelines, central pivot irrigators and relocation of power poles.	*Parwan-Balliang Irrigation District Foundation Recycled Water Irrigation Areas - Stage 1 - Ecological Impact Assessment* (CH2M Beca, 2023)	Known extent within project area based on on-ground surveys conducted in 2021	Known and potential habitat within project area based on on-ground surveys conducted from 2021 - 2023	Data not available	Data not available

*Projects and their total impacts were included if any of their footprint intersected the Study Area

25.6.5 DIRECT CUMULATIVE IMPACTS

Table 25-2 identifies the relevant protected matters directly impacted by the Plan that are also impacted by other projects in the Study Area.

For relevant protected matter, the table shows:

- Impacts from project in terms of hectares impacted and as per cent of habitat within the Study Area, and the total impacts
- Total cumulative impacts across the projects and Plan in terms of:
    - Total impact in hectares
    - Per cent increase in impact due to other projects
    - Total impact as per cent of remaining habitat within the Study Area

The table shows that the other projects contribute to cumulative impacts in relation to relevant protected matters directly impacted by the Plan. However, a contribution to cumulative impacts is only considered significant when the other projects have a total impact greater than 100 per cent of the impact of the Plan or greater than 2 per cent of remaining habitat within the Study Area (see Section 25.6.3). Therefore, the other projects make a significant contribution to cumulative impacts to Natural Temperate Grassland of the Victorian Volcanic Plain TEC and habitat for the potential recovery of Victorian Grassland Earless Dragon.

The total cumulative impact from the Plan and other projects is considered significant where total cumulative impacts were greater than 5 per cent of remaining habitat within the Study Area (see Section 25.6.3). A significant total cumulative impact across the Plan and other projects was not identified for any relevant protected matter.

Table 25-2: Potential cumulative impacts to species and TECs directly impacted by Plan

Protected matter	Total habitat in the Study Area	Plan impacts**		Other project impacts						Cumulative impacts Plan and other projects		
		Impact (ha)	Impact as % of Study Area habitat	Southern WGGA (ha)	Barwon Solar Farm (ha)	Vopak Victoria Energy Terminal (ha)	Parwan-Balliang Irrigation District (ha)	Total impact (ha)	Total impact as % of Study Area habitat	Total impact (ha)	% increase in impact due to major projects	Impact as % of Study Area habitat
Natural Temperate Grassland of the Victorian Volcanic Plain TEC	2,817.2	7.7	0.3%	17.0	8.41	7.04	0.42	**32.9**	**1.2%**	**40.6**	**426.9%**	**1.4%**
Striped Legless Lizard (*Delma impar*)	8,124.9	145.9	1.8%	6.9	0	7.04*	0.02	**14.0**	**0.2%**	**159.9**	**9.6%**	**2.0%**
Golden Sun Moth *(Synemon plana)*	20,418.3	642.2	3.1%	25.1	5.30	7.04*	0.02	**37.5**	**0.2%**	**679.7**	**5.8%**	**3.3%**
Victorian Grassland Earless Dragon *(Tympanocryptis pinguicolla)*[#]	19,956.2	77.5	0.4%	68.1	15.3^	7.04^	0.54^	**91.0**	**0.5%**	**168.47**	**117.4%**	**0.8%**

*Direct impacts are predicted, but were not quantified in the currently available public information. This impact number has therefore been calculated using EVC 132 Plains Grassland impacts, which may provide habitat for the species

**Note that the Plan impacts include potential direct impacts to modelled habitat within the portion of Heales Road East subject to process based development

^These referrals did not quantify impacts to the Victorian Grassland Earless Dragon due to the recent rediscovery and conservation advice. This impact number has therefore been calculated using EVC 132 Plains Grassland impacts, which may provide habitat attributes for the species. This is likely to be a conservative estimate of impacts to the species from these projects.

25.6.6 EVALUATION OF CUMULATIVE IMPACTS

APPROACH

The evaluation was undertaken considering the following questions:

- To what extent is the Plan contributing to cumulative impacts both individually and with the other projects?
- Do the current offset and mitigation measures under the Plan deal adequately with the cumulative impact?

MATTERS OF CONCERN

The purpose of the cumulative impact assessment is to determine if any relevant protected matters impacted under the Plan are also significantly impacted by other major projects in the Victorian Volcanic Plain bioregion to:

- Assess the significance of cumulative impacts
- Determine whether the commitments under the Plan are adequate in the context of the cumulative impacts

The relevant protected matters that are most likely at risk from cumulative impacts are those matters where (see Section 25.6.3):

- The Plan is having a notable impact, and
- The major projects make a significant contribution to cumulative impacts, and
- There is a significant total cumulative impact from the Plan and other projects

No relevant protected matters meet these criteria.

OFFSETS UNDER THE PLAN

The offset targets for each MNES subject to residual impacts provided under the Plan are:

- 13.9 ha of Natural Temperate Grassland
- 331.2 ha of known habitat for Striped Legless Lizard
- 500.7 ha of known habitat for Golden Sun Moth

Note that these offset targets do not compensate for potential direct impacts in the portion of Heales Road East subject to process based development. Residual impacts to MNES values in these areas will be offset in accordance with the EPBC Act Environmental Offsets Policy and associated Offsets Assessment Guide (Commonwealth of Australia, 2012a) (or equivalent) (see Section 8.6 of Part 2 for further details).

There are two components to strategic offsets under the Plan which will deliver the offset targets:

- Protection and management of the Northern Conservation Area and the Eastern Conservation Area in the NGGA
- Protection and management of the remaining offsets outside the Growth Areas

CONCLUSION

Based on the quantitative impact assessment undertaken for relevant protected matters directly impacted by the Plan and other projects, no relevant protected matters are considered to be at significant risk from cumulative impacts. This does not mean that cumulative impacts are not occurring for these matters, more so that cumulative impacts are considered to be moderate. Additionally, the contribution of cumulative impacts from the southern WGGA project is likely to be overestimated as the data is based on modelled habitat and further avoidance of habitat is expected to occur during the approvals process.

The commitments and offsets under the Plan are considered to adequately address these cumulative impacts. It is also considered that the Plan makes an adequate and substantial contribution to addressing landscape scale impacts (further discussed in the qualitative CIA below).

25.7 QUALITATIVE CIA

25.7.1 INTRODUCTION AND PURPOSE OF THE QUALITATIVE CIA

It is recognised that the Southern Volcanic Plain bioregion will be subject to many other types of development in the future, including:

- Smaller projects, such as smaller-scale infrastructure, residential or commercial developments
- Projects which were not considered as other projects in Section 25.6 due to direct impacts that could not be quantified, yet which have potential to result in indirect impacts over substantial areas
- Other projects which have not yet been planned or announced

It is not possible to quantitatively estimate the cumulative impacts of these developments and the Plan on MNES due to either a lack of available data on biodiversity impacts or uncertainty over the extent and location of development. However, the combined footprint and impacts of these projects have the potential to be substantial, particularly given the high development pressures and existing habitat degradation in the bioregion. These projects have potential to result in the following cumulative impacts to relevant protected matters within the Study Area:

- Direct impacts to and/or fragmentation of populations and/or habitat
- Exacerbated threatening processes from direct and indirect impacts

Furthermore, high development pressures in the area will increase the demand for offset sites for threatened matters in the region. The Strategic Assessment Area and wider bioregion has historically been cleared and degraded, and there are limited remaining areas of biodiversity. For species and TECs which are endemic to the region, there will be a finite availability of offsets which will eventually constrain permissible development that impacts protected matters.

This section outlines a qualitative analysis of the Plan with regards to the cumulative impacts of minor or future major projects, and considers:

- Whether the design of development under the Plan will assist in minimising potential cumulative impacts from development pressures within the Southern Volcanic Plain bioregion
- Whether the Plan contains measures to increase protection of the most valuable environmental assets within the Southern Volcanic Plain bioregion, to reduce their vulnerability to future development
- Whether the Plan contains measures which will help to minimise landscape-scale threatening processes which may occur due to cumulative impacts

25.7.2 CUMULATIVE DIRECT IMPACTS AND FRAGMENTATION

Most high value biodiversity areas within the Strategic Assessment Area are currently vulnerable to future development or continued degradation. The vast majority of the remaining native vegetation within the Southern Volcanic Plain bioregion is privately owned and the majority of remaining native vegetation is restricted to small, fragmented patches within agricultural land or riparian zones. Protection of native vegetation is also limited, and the Growth Areas currently do not contain any formal conservation reserves. However, several reserves are managed by the City.

The Plan minimises the risk of future cumulative direct impacts and fragmentation by increasing protection of remaining biodiversity areas. Increased protection will be delivered in multiple ways, as follows:

- Protection and management of native vegetation in the Strategic Assessment Area to conserve biodiversity values in perpetuity, including:
    - The Northern Conservation Area will be established in perpetuity to avoid and protect 77.7 ha of habitat for Striped Legless Lizard, 119.5 ha of habitat for Golden Sun Moth and 125.3 ha of potentially suitable areas for the recovery of Victorian Grassland Earless Dragon (Commitment 4)
    - Protection and management of 6.7 ha of habitat for Natural Temperate Grassland within the Eastern Conservation Area (Commitment 6)
    - Avoidance and protection of native vegetation which provides 3.4 ha of habitat for Striped Legless Lizard, 4.6 ha of habitat for Golden Sun Moth and 3.7 ha of habitat for Natural Temperate Grassland within the gully avoidance area (Commitment 8)
    - Protection and management of native vegetation and habitat for Growling Grass Frog and Adamson's Blown-grass within the Cowies Creek Conservation Area (Commitment 9)

- Establishment and management of offset sites in strategic locations to protect and manage a minimum of the following amounts of habitat confirmed through field surveys to support the following MNES (Commitment 16):
    - 13.9 ha of Natural Temperate Grassland TEC
    - 331.2 ha of habitat for Striped Legless Lizard
    - 500.7 ha of habitat for Golden Sun Moth

The location of conservation lands and avoided lands have been developed strategically to include areas of the most viable and best-connected remnant vegetation within the Strategic Assessment Area. Additionally, a significant proportion of these offsets will be delivered early in the life of the Plan, preventing further degradation of these areas and leading to more immediate landscape scale benefits. The increased and early protection will therefore improve outcomes for multiple MNES within the Strategic Assessment Area over the long term.

25.7.3 CUMULATIVE INDIRECT IMPACTS

The Strategic Assessment Area is already subject to existing indirect impacts and subsequent threatening processes from existing development. Many of these threatening processes operate at a landscape scale, and current management programs for these threats are often spatially limited and/or under resourced, meaning the threats are generally not being adequately managed. Even without delivery of the Plan, these threatening processes are predicted to intensify in the future due to the high development pressures in the region.

COMMITMENTS FOR INDIRECT IMPACTS

The Plan includes a range of commitments to minimise and manage indirect impacts. These commitments will not only minimise the risk of indirect impacts occurring under the Plan, but they also contribute to minimising and managing the existing landscape threats which already occur within the Strategic Assessment Area (see Section 3.4). These commitments include:

- Standard mitigation measures will continue to be implemented to minimise the indirect impacts of the development in accordance with the requirements of the Geelong Planning Scheme, as updated from time to time, and generally in accordance with the Framework Plan (Commitment 13)
- Additional specific mitigation measures will be implemented to minimise the indirect impacts of the development on protected matters associated with waterways, riparian areas and wetlands including (Commitment 15):
    - EPBC listed threatened and migratory birds
    - *Galaxiella toourtkoourt* (Little Galaxias)
    - *Litoria raniformis* (Growling Grass Frog)
    - *Nannoperca obscura* (Yarra Pygmy Perch)
    - *Prototroctes maraena* (Australian Grayling)
    - *Lachnagrostis adamsonii* (Adamson's Blown Grass)
    - Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site
- Additional specific mitigation measures will be implemented to minimise the indirect impacts of the development on the two NGGA Conservation Areas and Cowies Creek Conservation Area (Commitment 14), including:
    - Identify a conservation interface between urban development and the boundaries of the Conservation Areas
    - Design and baffle public lighting in accordance with National Light Pollution Guidelines for Wildlife to prevent light spill and glare within the Cowies Creek Conservation Area
    - Prepare Construction Environmental Management Plans for construction works on land immediately adjacent to the Conservation Areas

25.7.4 OFFSET AVAILABILITY

The availability of offsets is a key risk for development projects, particularly large scale projects (such as strategic assessments) within already cleared and/or degraded landscapes. The City identified offset availability as key component of the offset package for the strategic assessment. Supporting Document D to this assessment report provides details of the offset package, including an analysis of offset availability. This analysis determined that there is sufficient offset availability for the strategic assessment but emphasised the importance of securing offsets as early as possible.

A key benefit of the strategic assessment is coordinated offset delivery within the NGGA (the Northern and Eastern Conservation Areas). This was a priority for the strategic avoidance planning process and provides in-situ protection

and management of the three MNES subject to direct impacts, local to the areas impacted by development under the Plan. The delivery of these conservation areas contributes:

- 49 per cent of the total Natural Temperate Grassland offset target
- 23 per cent of the total Striped Legless Lizard offset target
- 24 per cent of the total Golden Sun Moth offset target

25.7.5 EVALUATION

Overall, the Plan is considered to minimise the risk of adverse cumulative impacts to biodiversity values, as:

- The Plan will increase the protection of remaining areas with biodiversity values within the Strategic Assessment Area and wider Victorian Volcanic Plain bioregion, thereby decreasing the risk of future development in these areas
- The Plan includes a range of measures which will address and minimise existing landscape-scale threatening processes which are exacerbated by development
- By increasing protection from development over areas of biodiversity value in the conservation areas and offset sites, and providing these areas early in the life of the Plan, the Plan assists in ensuring availability of offsets

26 Socio-economic impact assessment

26.1 INTRODUCTION

26.1.1 ASSESSMENT REQUIREMENTS

Both the ToR and the EPBC Act require consideration of social and economic matters in relation to the assessment of the Plan.

ToR REQUIREMENTS

The relevant ToR are outlined in the following text box.

> *8.1. The Report must assess the social and economic impacts of the Plan.*
>
> *8.2. The Report must describe the consultation with the public (including affected parties) undertaken during the development of the Plan.*
>
> *8.3. The Report must describe the process by which parties who may be affected by the strategic assessment will be accorded natural justice and procedural fairness as part of the assessment of impacts of the plan.*

EPBC ACT REQUIREMENTS

In addition to the ToR, Section 146F of the EPBC Act requires the Minister to consider social and economic matters when considering the approval of actions in accordance with an endorsed policy, plan or program.

26.1.2 STRUCTURE OF THIS CHAPTER

This Chapter is designed to address the ToR and provide information to meet the requirements of Section 146F. It provides an assessment of the socio-economic impacts of the Plan and is structured as follows:

- The approach to the socio-economic impact assessment is described
- The socio-economic impact assessment is presented
- Relevant consultation processes are described
- The way in which the strategic assessment process provides procedural fairness is outlined

26.2 APPROACH TO THE SOCIO-ECONOMIC IMPACT ASSESSMENT

26.2.1 METHODOLOGY

The methodology applied in this chapter is based around undertaking a high-level qualitative socio-economic impact assessment based on the approach set out by (Vanclay, Esteves et al., 2015).

The first step of the socio-economic impact assessment is to provide an overview of the socio-economic context and growth of Geelong. This is to provide an understanding of the context that has informed the analysis.

The socio-economic impact assessment uses an approach set out by (Vanclay, Esteves et al., 2015). This approach establishes principles for social impact assessment and suggests that social impacts can be conceptualised as changes to one or more of the following aspects of the community:

- People's way of life
- Their culture
- Their community
- Their political systems
- Their environment
- Their health and wellbeing
- Their personal and property rights
- Their fears and aspirations

Although this approach is considered to be a social impact assessment approach, the aspects are relevant to both social and economic factors and the quantitative data for social and economic factors is often inter-related. The socio-economic impact assessment undertaken in this chapter has therefore considered these aspects both socially and economically.

Table 26-1 identifies the socio-economic components of the aspects that are relevant to the Plan. These components were identified based on the current context of Geelong and the socio-economic factors that may be impacted by implementation of the Plan. Although some components are relevant to multiple socio-economic aspects, for the purposes of the impact assessment each component has only been assigned to one aspect.

Table 26-1: Components considered to be relevant to the Plan for each of the socio-economic aspects as defined in (Vanclay, Esteves et al., 2015)

Aspect	**Definition** (Vanclay, Esteves et al., 2015)	**Socio-economic components of the aspect relevant to the Plan**
People's way of life	That is, how they live, work, play and interact with one another on a day-to-day basis	• Employment • Training and education • Transport • Arts and recreation
Their culture	That is, their shared beliefs, customs, values and language or dialect	• Traditional owners • Ethnicity and language • Religion
Their community	Its cohesion, stability, character, services and facilities	• Public services • Post-contact heritage • Housing
Their political systems	The extent to which people are able to participate in decisions that affect their lives, the level of democratisation that is taking place, and the resources provided for this purpose	The relevant components of this aspect are consultation and procedural fairness. These are specifically addressed in Section 26.4 and not further discussed in this section
Their environment	The quality of the air and water people use; the availability and quality of the food they eat; the level of hazard or risk, dust and noise they are exposed to; the adequacy of sanitation, their physical safety, and their access to and control over resources	• Biodiversity • Air quality • Water resources • Fire risks • Hazard, risks or dust • Access to natural spaces • Visual amenity
Their health and wellbeing	Health is a state of complete physical, mental, social and spiritual wellbeing and not merely the absence of disease or infirmity	• Mental health • Physical health
Their personal and property rights	Particularly whether people are economically affected, or experience personal disadvantage which may include a violation of their civil liberties	• Land use change
Their fears and aspirations	Their perceptions about their safety, their fears about the future of their community, and their aspirations for their future and the future of their children	The Geelong community is diverse and has a wide range of fears and aspirations. Community concerns and aspirations are considered throughout the other aspects where relevant

For each of the socio-economic components identified in Table 26-1, the impact assessment provides:

- A description of the current context for Geelong

- An assessment of how the Plan may impact the component

Socio-economic impacts (positive and negative) are considered qualitatively in a broad manner, whereby potential influences or changes to each component as a result of the Plan are described.

The impacts are considered across the community of Geelong, with a particular focus (where possible) on:

- Existing residents and landowners of the Growth Areas
- Nearby residents of the Growth Areas
- Future residents of the Growth Areas

26.2.2 DATA

The data and information used to inform the socio-economic impact assessment was drawn from:

- Community and stakeholder consultation undertaken as part of the identification and planning for the Growth Areas and for the strategic assessment to date. See Section 26.4.1 below for a description of the consultation processes relevant to the project
- Publicly available information sources including:
    - 2021 Australian Census data (Australian Bureau of Statistics, 2022)
    - 2023 population data from the Australian Bureau of Statistics (Australian Bureau of Statistics, 2023)
    - City of Greater Geelong plans, strategies and resources. For example, the NWGGA Framework Plan (The City of Greater Geelong, 2021b) and the City of Greater Geelong Community Plan (The City of Greater Geelong, 2021a)
    - Geelong Region Alliance (G21) resources (Geelong Region Alliance, 2007, 2019)

26.2.3 LIMITATIONS

The approach to the socio-economic impact assessment addresses the requirements of the ToR and EPBC Act. However, there are two key limitations. They are:

- A lack of specific consultation across the Geelong community to inform the socio-economic impact assessment
- A lack of a quantitative economic assessment

LACK OF SPECIFIC CONSULTATION

Although information and data from consultation related to Growth Areas was utilised, this data was not specifically collected to inform a socio-economic impact assessment or was collected as part of another earlier process such as the Framework Plan or G21 planning. However, the consultation data along with other publicly socio-economic data is considered adequate to undertake a socio-economic impact assessment that addresses the ToR.

Additionally, the full extent of the social impact of development is difficult to capture as society is dynamic and complex (Vanclay, Esteves et al., 2015). It is acknowledged that therefore makes it impossible to fully understand and represent the views of all members of society. The needs of and the processes impacting on a society are constantly changing and, therefore, require assessment over time. This ongoing assessment of the socio-economic impact of the Plan is built into the life of the Plan as part of the adaptive management approach under the MERI framework (refer to Chapter 2, Section 9.5).

LACK OF QUANTITATIVE ECONOMIC ASSESSMENT

This socio-economic impact assessment does not provide a specific quantitative economic impact assessment of development in the Growth Areas. To enable a comprehensive assessment of economic impacts, detailed quantitative data would need to be collected and analysed. However, this is not considered to be within the scope of this SAR, and accurate economic projections are challenging at this stage of the project because of:

- The long implementation timeframe of the Plan, which will provide for development over a period of 30 years
- The staged nature of development through the precinct planning process. While detailed information for two of the earlier precincts is being developed, precinct planning for the remaining precincts has not begun

The economic impact assessment presented in this section is considered adequate to addresses the requirements of the ToR. Additionally, there will be ongoing assessment of the socio-economic impact of the Plan as part of the adaptive management process under the Plan's MERI framework. This will enable relevant assessment of economic impacts over the life of the Plan (refer to Chapter 2, Section 9.5).

However, it is noted that quantitative economic data was considered as part of the Structured Decision Making process to determine the layout of avoidance and development within the Growth Areas. This process was designed to balance the competing land-use values in the Growth areas which include (but are not limited to):

- The need to deliver housing in the Growth Areas
- The need to meet regulatory requirements relating to biodiversity (including avoidance and offset prescriptions)
- The need to deliver good planning and environmental outcomes
- The value of engaging transparently and collaboratively with stakeholders

The SDM process compared and analysed a range of different layouts for the Growth Areas against a set of objectives. Objective three was designed to consider the economic implications of the chosen layout: "*Ensure the cost of the conservation program is feasible*". This objective recognises that the cost of the conservation program will have implications for feasibility and is part of the social and economic considerations which are a key component of the Part 10 strategic assessment under the EPBC Act.

As part of this objective, the following costs were measured:

- Acquiring land within the NGGA for conservation
- Managing conservation areas
- Monitoring conservation areas
- Offsets outside the Growth Areas

One of the key considerations when deciding on the final layout presented in the EPBC Plan was if the layout is likely to be deliverable from an economic perspective. On balance, when considering environmental, social, and economic priorities, the chosen layout performed the best and was determined to be deliverable. The SDM process, and the economic components considered, is presented in detail in Supporting Document C.

26.3 SOCIO-ECONOMIC IMPACT ASSESSMENT

26.3.1 INTRODUCTION

This section provides the socio-economic impact assessment of the Plan. As outlined in Section 26.2.1, the assessment uses the approach set out by (Vanclay, Esteves et al., 2015) and addresses the following aspects of the community:

- People's way of life
- Their culture
- Their community
- Their environment
- Their health and wellbeing
- Their personal and property rights

An overview of the socio-economic context and growth of Geelong is provided followed by an analysis of each of the aspects set out above.

26.3.2 OVERVIEW OF THE SOCIO-ECONOMIC CONTEXT AND GROWTH OF GEELONG

Geelong occurs approximately 75 kilometres from Melbourne. It is the largest regional centre in Victoria and supports a population of over 282,000 people (Remplan, 2022; Australian Bureau of Statistics, 2023). The local government area is 1,252 km^2 in size and is comprised of country, coastal and suburban areas (The City of Greater Geelong, 2021a).

The population of Geelong was recorded at 126,800 in 1981. Since the early 2000s, Geelong has experienced rapid population growth (DELWP, 2010). The population is expected to grow to 393,216 by 2041 (The City of Greater Geelong, 2022b).

The population is diverse in age, with the most dominant age groups as of 2021 being 35 – 49 (18.9 per cent of the population) and 25 – 34 (14.1 per cent of the population). Geelong appears to be supporting an increasingly aging population (Informed Decisions, 2022b).

Geelong has had strong economic growth in recent years, with an estimated Gross Regional Product of $15.4 billion, 19,600 businesses, and 120,000 local jobs. When compared to similar regions and cities across Australia, Geelong has had the higher growth in Gross Regional Product, jobs, and employment (The City of Greater Geelong, 2022d). Dominant industry sectors in Geelong include (Informed Decisions, 2022b; The City of Greater Geelong, 2022d):

- Healthcare and social assistance
- Retail trade
- Construction
- Education and training
- Public administration and safety
- Manufacturing

WADAWURRUNG COUNTRY

The Country known now as Geelong was occupied for at least 45,000 years by traditional owners prior to European Settlement. The traditional owners are the Wadawurrung Aboriginal people, meaning "the people who belong to the water". Geelong occurs within the area of the Kulin Nation, comprised of five communities including Wadawurrung. Land of the Kulin people covers approximately two million hectares. Communities of the Kulin Nation share similar languages and the same belief system (Rowe, 2021).

The Wadawurrung is comprised of 25 clans, each of which speak the same language or a similar dialect. The Wadawurrung people lived in the Geelong landscape in accordance with seasonal changes (Rowe, 2021).

European settlement had a devastating impact on the Wadawurrung people, including the dispossession of traditional land practices, food gathering and customs. The Wadawurrung population was also severely impacted by the introduction of European diseases. European settlement was responsible for conflict between the Wadawurrung people and settlers, resulting in a number of killings of Wadawurrung people. European settlement also increased tension and conflict between Aboriginal language groups (Rowe, 2021).

European settlement reduced the Wadawurrung population from thousands to about 70 people. The Wadawurrung population today is comprised of approximately 600 people, all descendants of the apical ancestor John Robertson (Wadawurrung Traditional Owners Aboriginal Corporation, 2020).

POST EUROPEAN SETTLEMENT

The earliest European exploration of Geelong was in 1802 by Lieutenant John Murray. Pastoralists arrived at Point Henry in the 1830s (Rowe, 2021). Geelong's industry began with an emphasis on wool production and sheep farming. For many years, Geelong was known as the wool centre of the world (Visit Victoria, 2022).

The twentieth century saw an expansion in the manufacturing sector in Geelong (DELWP, 2010). During this time, a number of large companies established a presence in Geelong including Ford Motor Company, Cresco fertilisers, Godfrey Hirst, and Pilkington's Glass. For much of the twentieth century, Geelong was considered a booming regional manufacturing centre (Johnson, Bartel et al., 2020).

The economy of Geelong experienced a shift towards professional services, health care and education in the twenty-first century (Johnson, Bartel et al., 2020). The decline in manufacturing in Geelong has had a strong impact on the region, causing unemployment and a level of social disadvantage in some areas. Despite these changes, Geelong is still considered as a manufacturing centre, although the nature of the industry has shifted towards jobs that require higher skill levels and capital modes of production (DELWP, 2010).

Since the initial arrival of Europeans, Greater Geelong has welcomed immigrants from many parts of the world shaping the multicultural population observed today (Rowe, 2021).

SOCIO-ECONOMIC GROWTH AND DEVELOPMENT WITHIN THE GROWTH AREAS

G21 and the identification of the Growth Areas

The growth of Geelong has long been recognised. To help address the challenges and opportunities associated with the growth of the region, the Geelong Region Alliance was established. The region alliance is a collaboration between government, business and the local community within the Geelong region (G21 region) (Geelong Region Alliance, 2007).

The region alliance has undertaken a range of work to addresses the challenges and opportunities of future growth in the G21 region, including the development of the *G21 Geelong Region Plan – a sustainable growth strategy* (G21 Region Plan) (Geelong Region Alliance, 2007). The G21 Region Plan was developed to establish a strategic framework for the environment, settlement, land use, community cohesion and the economy in the G21 region. The region plan identified how challenges for future growth may be addressed, including the delivery of priority projects to enable future productivity, liveability and sustainability. The research undertaken to inform the G21 region plan included a projection of future population growth within the G21 region of 500,000 people by 2050 (Geelong Region Alliance, 2007).

Further documents to build upon the initial G21 Region Plan were also developed. The *G21 Regional Growth Plan* established a framework for strategic land use and settlement planning to promote a self-sustaining region that supports a stronger and more robust economy and attracts a diverse community (Geelong Region Alliance, 2013). The *G21 Region Economic Development Strategy* identified the key initiatives that are most critical in driving beneficial socio-economic growth for the region and how they are supported by broader strategic objectives (Geelong Region Alliance, 2014). The *G21 Region Profile* was prepared in 2019 and provides updated region-level demographic, socio-economic, health, community, environmental and economic data (Geelong Region Alliance, 2019).

The work undertaken as part of the G21 identified the Growth Areas as 'further investigation areas' to support the projected future urban growth and informed the subsequent development of the Framework Plan.

The Framework Plan

The City subsequently developed the *Northern and Western Geelong Growth Areas Framework Plan* (the Framework Plan) (The City of Greater Geelong, 2021b), which describes the Growth Areas and outlines considerations for their future development until 2047. The Growth Areas are the key areas identified for development to support Geelong's long-term growth. This growth is driven by a strong economy and employment opportunities that are expected to continue in the coming decades (Geelong Region Alliance, 2007; The City of Greater Geelong, 2021b).

The Framework Plan is a high-level strategic document that:

- Outlines considerations for future development in the Growth Areas
- Describes the existing social, economic and environmental context of the Growth Areas
- Summarises pre-existing technical investigations
- Provides an overarching vision for the Growth Areas and subsequent objectives and actions to achieve the vision
- Outlines concept plans for future land uses within the Growth Areas

A key function of the Framework Plan is to guide the future preparation of detailed Precinct Structure Plans (PSPs) for the Growth Areas, which will set-out the specific land uses within each urban precinct.

The Framework Plan is incorporated into the Geelong Planning Scheme at Clause 11.02.

A clever and creative future

The City have prepared *Greater Geelong: A Clever and Creative Future* to guide development in the Geelong region. This document represents the Geelong community's vision for the future and was prepared in consultation with over 16,000 Geelong residents. This is a key resource for designing and establishing the new communities in the Growth Areas (The City of Greater Geelong, 2021b, 2022a). *A Clever and Creative Future* includes nine community led aspirations which will be implemented throughout the development of the Growth Areas. These include (The City of Greater Geelong, 2022a):

- A prosperous economy that supports jobs and education opportunities
- A leader in developing and adopting technology
- Creativity drives culture
- A fast, reliable and connected transport network

- People feel safe wherever they are
- An inclusive, diverse, healthy and socially connected community
- Sustainable development that supports population growth and protects the natural environment
- Development and implementation of sustainable solutions
- A destination that attracts local and international visitors

26.3.3 PEOPLE'S WAY OF LIFE

EMPLOYMENT

As of 2021, approximately 95.6 per cent of the Geelong population was employed. Of this, 53.1 per cent were employed full time, and 35.7 per cent were employed part time. The dominant industry sector in Geelong as of 2016 was health care and social assistance (17.4 per cent) (DELWP, 2010). One of the largest employers in Geelong is Barwon Health. This is reflective of the increased demand for aged care in the region associated with the ageing population (DELWP, 2010). Other key industries included retail trade (10.6 per cent), construction (11.2 per cent), and education and training (9.8 per cent) (Informed Decisions, 2022b).

Individual income levels in Geelong as of 2021 indicate that of the population over 15 years of age, 32.3 per cent of people earn a low income (less than $500 per week), and 10.6 per cent of people earn a high income ($2,000 or more per week). Younger residents (aged 15 – 19) and older residents (greater than 50 years) are more likely to earn less than $400 per week. The average income of Indigenous peoples living in the Geelong region is lower than for non-indigenous peoples (Geelong Region Alliance, 2019).

TRAINING AND EDUCATION

The completion of Year 12 in the Geelong region is lower than the Victorian average. However, the proportion of students who have completed year twelve has increased consistently from 39.9 per cent in 2006 and 45.1 per cent in 2011 to 50.6 per cent in 2016, and to 53.2 per cent in 2021 (Informed Decisions, 2022b)

The Geelong region has a lower number of persons with Bachelor or Higher degree qualification than the Victorian average. There are more women with Bachelor or Higher degree qualifications than men (Informed Decisions, 2022b).

TRANSPORT

A large number of residents in the Geelong region travel long distances to get to their workplace, including to the Melbourne CBD or inner suburbs. Travel to the Melbourne CBD for work has influenced an increased use of rail services. There are also a number of Greater Melbourne residents which travel to the Geelong region for work (Geelong Region Alliance, 2019).

Residents of Greater Geelong are considered to have relatively good access to public transport. More rural areas in the Geelong region tend to have a smaller population and have limited access to facilities and services like public transport. Approximately 76.9 per cent of the Greater Geelong population lives within 400 m of a public transport network (Geelong Region Alliance, 2019).

The proportion of Geelong residents who own a private vehicle is higher than the Victorian state average. Approximately 59.6 per cent of households in the Geelong region own two or more vehicles. Private vehicle ownership is a key component of the way Geelong residents travel daily given the limited access to public transport for some in more rural areas. Geelong residents are less likely to travel to work by train, bicycle, or working when compared with the Victorian average (Geelong Region Alliance, 2019).

ARTS AND RECREATION

Data from 2013/2014 indicates that a large proportion of the Geelong population over the age of 15 attended arts or cultural events (just under 90 per cent). Popular activities include cinemas, music events, libraries or archives, performing arts, art galleries, and museums (Geelong Region Alliance, 2019).

The City of Geelong has been designated as Australia's first and only City of Design. This designation assists in driving new business and creative talent in Geelong and provides opportunities for local Geelong designers to showcase their work to other Cities of Design globally (Geelong Region Alliance, 2019).

IMPACTS OF THE PLAN

Employment, education and training

The development supported by the Plan will generate substantial business opportunities and create jobs across a range of employment sectors including commercial business, industry, education, health care, transport and agriculture. Additionally, the construction phases of development under the Plan will boost the economy of the region and generate many jobs that will be sustained over the coming decades as each precinct is released and developed (The City of Greater Geelong, 2021b).

The Growth Areas are also near the Geelong Ring Road Employment Precinct, Port of Geelong, Avalon Airport and Melbourne, which will facilitate further employment opportunities and economic growth for these areas (The City of Greater Geelong, 2021b).

Implementation of the Plan will therefore provide new employment, training and education opportunities for both current and future residents, as well as nearby residents. This is likely to provide economic growth and benefits to Geelong and may lead to positive changes and diversification of the workforce in the Geelong region and influence the level of employment.

Transport

Development under the Plan will facilitate new public and private transport networks and corridors which will allow current and future residents and visitors to easily travel to and from the Growth Areas, as well as access facilities within the Growth Areas. Linkages and access points will be established to existing transport corridors such as the Geelong Ring Road to maximise use of existing transport infrastructure (The City of Greater Geelong, 2021b).

Public transport including buses and rail will be prioritised within the Growth Areas to help promote more sustainable transport options. Additionally, open spaces within the Growth Areas will be maximised to allow for shared pathways that will facilitate sustainable transport linkages, such as via walking and cycling, throughout the Growth Areas (The City of Greater Geelong, 2021b). This will provide new transport options and facilities for current and future residents, as well as visitors of the Growth Areas.

Arts and recreation

The Plan will facilitate the delivery of community infrastructure including libraries, art and cultural centres, sports facilities and function spaces. Community open spaces, including recreation reserves and local parks, will also be integrated into the layout of the Growth Areas, providing residents and visitors with new community and recreation opportunities (The City of Greater Geelong, 2021b). New art and recreation opportunities may also attract new businesses and investment in Geelong which may lead to increased tourism. This is likely to result in positive economic impacts and growth for Geelong.

Conclusion

Implementation of the Plan will provide new opportunities and growth in employment, education and training, transport, and arts and recreation. This will lead to overall positive socio-economic impacts for current, future and nearby residents and visitors of the Growth Areas.

26.3.4 THEIR CULTURE

TRADITIONAL OWNERS

As of 2021, approximately 1.3 per cent of the Geelong population comprises Aboriginal and Torres Strait Islander peoples (Informed Decisions, 2022b). The Indigenous population of Geelong is skewed towards younger generations, with about 54 per cent of the Indigenous population under 24 years of age. The under-representation of Indigenous people in older age groups is consistent with lower life expectancy figures. The life expectancy for Indigenous peoples is 67.2 years for males and 72.9 years for females compared with 78.7 years for non-Indigenous males and 82.6 years for non-Indigenous females (Geelong Region Alliance, 2019).

There are a number of registered Aboriginal places across the Growth Areas, comprised mostly of stone artefacts. The nature of the land in the NGGA suggests that the Wadawurrung people would have used the area for ephemeral activities (such as hunting and gathering) rather than long term occupation (The City of Greater Geelong, 2021b).

There has been limited archaeological investigation within the Growth Areas, and the available data may not accurately reflect land use by the Wadawurrung. Preliminary Aboriginal site sensitivity mapping has indicated areas of high archaeological potential along the waterways in the WGGA and one area in the NGGA near to a registered stone artefact (The City of Greater Geelong, 2021b).

ETHNICITY AND LANGUAGE

The community of Geelong has a diverse cultural profile. Ancestry data indicates that the 10 most prevalent ancestries include English, Australian, Irish, Scottish, Italian, German, Dutch, Indian, Croatian, and Chinese. English and Australian ancestries comprise 28 and 36 per cent of the population respectively. Irish and Scottish ancestries comprise 13 and 12 per cent of the population respectively. Remaining ethnicities comprise less than five per cent of the total Geelong population (Informed Decisions, 2022b).

Approximately 17.7 per cent of the Geelong population was born overseas, including the United Kingdom (4.1 per cent), India (1.9 per cent), New Zealand (1.1 per cent), and a number of other countries contributing to <1 per cent of the total population's birthplace. Approximately 11.7 per cent of the Geelong population speaks a language other than English at home. The most common languages spoken include Mandarin, Punjabi and Italian (Informed Decisions, 2022b).

RELIGION

The largest religious group as of 2021 in Geelong was Western (Roman) Catholic, comprising 22.2 per cent of the total population. Approximately 42 per cent of people did not identify with a religion in Geelong. There are a number of other religions contributing to the cultural diversity of Geelong, including Anglican (8 per cent of the population), Uniting Church (3.7 per cent of the population), and Presbyterian and Reformed (1.9 per cent of the population) (Informed Decisions, 2022b).

IMPACTS OF THE PLAN

As part of implementation of the Plan, the City aims to recognise and protect Aboriginal sites and work in partnership with the Wadawurrung people to interpret and manage Aboriginal heritage sites in the Growth Areas (The City of Greater Geelong, 2021b). Further consultation with Traditional owners will also be undertaken as part of the strategic assessment process and Plan implementation (see Section 26.4.1).

The Plan will facilitate urban development in the Growth Areas which will provide capacity to support the projected future population growth of Geelong (The City of Greater Geelong, 2021b). As new residents move to the Growth Areas and the population grows, the composition and diversity of religion, ethnicity and language will change.

It is not possible to accurately predict the exact changes to culture, as new residents may comprise of a more diverse population, but existing residents may also emigrate from the Growth Areas. Although the Plan will influence the culture of Geelong, it is not expected to have a substantial positive or negative effect.

26.3.5 THEIR COMMUNITY

PUBLIC SERVICES

Greater Geelong includes a number of public services and facilities. This includes (note that this list is not exhaustive and doesn't include hotels, restaurants, cafes, nightclubs, and churches) (The City of Greater Geelong, 2018):

- 74 aged care/nursing homes
- 35 caravan parks
- 18 childcare centres
- 34 kindergartens
- 51 community halls
- 44 disability centres
- 5 hospitals
- 20 maternal and childcare centres
- 127 schools
- 19 senior citizen centres
- 3 amusement parks

- 4 permanently staffed country fire authority stations
- 4 major police stations

The Geelong region has a higher than the Victorian average rate of access to community services and resources. Greater Geelong is well serviced with health and medical services. Public services in the Geelong region are impacted by temporary fluctuations in population associated with increased tourism during holiday seasons (Geelong Region Alliance, 2019).

POST-CONTACT HERITAGE

Post contact heritage values in the NGGA are mostly related to the early settlement of large pastoral estates, and the eventual subdivision to small-scale freehold agricultural enterprises. Post contact heritage values within the WGGA are related to early settlement of large pastoral estates, rail and road infrastructure, quarrying and the history of the Fyansford and Batesford townships (The City of Greater Geelong, 2021b).

HOUSING

The demand for housing in Geelong is driven by household formation patterns and population growth. Affordability of housing is a key constraint for the region. The number of people who own a home in Geelong is broadly consistent with the Victorian average. The median mortgage repayments in Geelong were $1,540 per month in 2016. This is approximately 9 percent less than the Victorian state median of $1,700 (Geelong Region Alliance, 2019).

There are less people renting in Geelong (23.5 per cent) than the Victorian Average (26.7 per cent). The average rental price in the Geelong region was $280 per week as of 2016, $45 per week less than the Victorian average. Approximately 21.1 per cent of the rental dwellings in Geelong were identified as affordable in 2018 (Geelong Region Alliance, 2019).

The City provides social housing for people on low incomes who need housing. Approximately 12.6 per cent of all rental dwellings in the Geelong region are occupied through public housing (3,680 dwellings). As of 2018, it was estimated that the total number of applicants for social housing in the Barwon Area was 2,699 (Geelong Region Alliance, 2019).

The Geelong region has experienced a growth in homeless people between 2011 and 2016. The homeless proportion of the Geelong region population was 0.3 per cent in 2016. This is lower than the state average (0.4 per cent) (Geelong Region Alliance, 2019).

IMPACTS OF THE PLAN

Public services

Development of the Growth Areas under the Plan will facilitate new public services and infrastructure that will be required to support the increasing population. This will add to the already high level of access to community services and resources for both current and future residents, and nearby residents of the Growth Areas. The increase in public services may also assist with fluctuations associated with increased tourism during holiday seasons (Geelong Region Alliance, 2019).

Post-contact heritage

The city aims to protect existing post-contact heritage sites and integrate them into the design of the Growth Areas. This will help provide the community with a sense of place and add character to the Growth Areas, potentially leading to positive community impacts for current and future residents (The City of Greater Geelong, 2021b). Protecting and integrating these sites may also lead to added tourism and economic benefits for the community due to people visiting the sites from outside of the Geelong region.

Housing

Recently (partly the result of the COVID-19 pandemic), housing availability has not adequately kept pace with demand, which has led to high house and land prices (Ratio, 2022). This trend has been seen across most of Australia and supply of affordable housing is needed (Informed Decisions, 2022a; Ratio, 2022). The Framework Plan was developed in consideration of the projected increase in Geelong's growth and aimed to help supply the urban land required to support Geelong's future growth.

The development supported by the Plan aims to provide a sustainable and diverse mix of housing and accommodation to support future residents and visitors of Geelong. Diverse housing is important for the success of new urban areas, as it

attracts a range of potential residents at all stages of their life. The City intends to provide a mix of low-rise, multi-unit and clustered housing types, along with aged-care and affordable, community and social housing options (The City of Greater Geelong, 2021b).

The Growth Areas have the capacity to accommodate 110,000 new residents. In additional to residential housing, a range of other accommodation types will also be provided including hotels, motels and caravan and camping parks. Existing rural living spaces will also be retained in some areas, providing opportunities for agriculture and rural industry (The City of Greater Geelong, 2021b).

The increased availability and variety of housing options provided in the Growth Areas may relieve pressure on the current housing market and result in positive socio-economic impacts for current and future residents of Geelong.

Conclusion

Implementation of the Plan will provide new public service facilities and infrastructure and will supply a diverse mix of housing and accommodation to help support the future population growth of Geelong. Existing heritage sites will also be protected and integrated into the Growth Areas. Overall, the Plan is therefore likely to result in positive community related socio-economic impacts for current, future and nearby residents of the Growth Areas.

26.3.6 THEIR ENVIRONMENT

BIODIVERSITY

The Geelong region supports a range of biodiversity values such as flora and fauna, ecological processes and natural habitats throughout rural lands, waterways, coastal reserves, grasslands, forests, nature reserves and streetscapes. Aside from its inherent value, biodiversity provides important benefits for the community of Geelong including clean water and air, carbon sequestration, pollution and flood mitigation, productive soils, natural pest control, and visual amenity (The City of Greater Geelong, 2020b).

Biodiversity in the Geelong region is in serious decline. Urgent action is necessary to prevent further decline, provide protection, and enhance and restore these values (The City of Greater Geelong, 2020b).

A detailed description and impact assessment of biodiversity values listed under the EPBC Act is provided throughout Part 4 of the SAR.

AIR QUALITY

Air quality in the Geelong region is monitored at Geelong South against national air quality objectives and goals. Measuring results for Geelong in 2017 indicate that air quality in Geelong was (Geelong Region Alliance, 2019):

- Good to very good on 286 days
- Poor to very poor on 31 days

WATER RESOURCES

Water sources in Geelong are diverse, including groundwater, recycled water, water from Melbourne, and water from rivers and reservoirs. The availability of water resources in the Geelong region is expected to be impacted by climate change (Geelong Region Alliance, 2019). Population growth is also expected to put pressure on water supply in Geelong.

FIRE RISKS

The majority of the Geelong region is susceptible to bushfires. Aside from urban areas, remaining land has been defined as a 'bushfire prone area'. This risk is likely to be exacerbated in future climate scenarios (Geelong Region Alliance, 2019).

OTHER HAZARDS AND RISKS

The City has identified a number of hazards and risks to Geelong. These include (The City of Greater Geelong, 2022e):

- *"Heatwaves or drought*
- *Epidemics or pandemics*
- *Severe storms*

- *Riverine and flash flooding*
- *Major road and rail transport accidents*
- *Structural fires*
- *Bushfires*
- *Actions of terrorism*
- *External incidents that may impact – power failure, contamination of water supply"*

The City has a Municipal Emergency Management Plan in place to manage these risks (note this is currently under reform). This includes a Community Emergency Risk Assessment process (The City of Greater Geelong, 2022e).

ACCESS TO NATURAL SPACES

Access to open spaces, walking trails, and sports facilities is important for community. Providing the community with adequate access to safe environments to exercise is an ongoing priority for the City. Data indicates that more adults are meeting physical activity guidelines. However, the number of adults who spend greater than 8 hours per day sitting has increased (The City of Greater Geelong, 2021a).

Throughout Geelong, there is an estimated 1,300 ha of protected natural areas. Further, 2,146.8 ha within Geelong is designated as open public space (The City of Greater Geelong, 2021a).

VISUAL AMENITY

Amenity refers to the desirability, attractiveness, pleasantness, or utility of an area. Amenity is an important consideration for a number of stakeholders and the community (DPE, 2022). Amenity within neighbourhoods encourages residents to use and enjoy their surroundings in daily life. This may promote health and well-being by creating communities which are set within a healthy environment. Further, amenity will support businesses, attract new residents and facilitate major infrastructure and investment in arts and recreation (The City of Greater Geelong, 2021b).

IMPACTS OF THE PLAN

Biodiversity

In developing the Plan, the City applied the avoid, mitigate, and offset hierarchy to protect biodiversity within and around the Growth Areas. The Plan includes a conservation framework that sets out commitments that will be delivered for:

- Avoiding and minimising impacts to MNES
- Mitigating impacts to MNES
- Offsetting residual impacts to MNES

Avoidance and minimisation of impacts to high value areas of biodiversity has been a key focus of the Plan. This included:

- Avoidance of an additional important area in the NGGA that was focused on areas in better condition, connected to previously identified conservation area, likely to be viable in the long term
- Avoidance of the Moorabool River and Cowies Creek Conservation Area in the WGGA
- Designing and locating external infrastructure development to avoid and minimise impacts to MNES and native vegetation
- Preparing management plans for the protection and ongoing management of Striped Legless Lizard and Golden Sun Moth within the Northern Conservation Area and for the Growling Grass Frog and areas of potential habitat for Adamson's Blown-grass within the Cowies Creek Conservation Area

Mitigation measures will also be implemented under the conservation framework to further reduce impacts to biodiversity. This includes:

- Continuing to implement standard mitigation measures to minimise the indirect impacts of the development on MNES in accordance with the requirements of the Geelong Planning Scheme, as updated from time to time, and generally in accordance with the Framework Plan

- Implementing additional specific mitigation measures to minimise the indirect impacts of the development on the Northern Conservation Area, Cowies Creek Conservation Area, and MNES associated with waterways, riparian areas and wetlands

Offsetting impacts to MNES is the final step in the offset mitigation hierarchy. Although impacts have been avoided, minimised, and mitigated as much as possible under the conservation framework, there are some remaining residual impacts that will occur as a result of the proposed development under the Plan. Offsetting of these impacts under the conservation framework includes:

- Establishing the Northern Conservation Area to protect and manage native vegetation and habitat for Striped Legless Lizard and Golden Sun Moth in perpetuity
- Establishing offset sites in strategic locations outside the Growth Areas to protect and manage habitat for MNES including Natural Temperate Grassland, Striped Legless Lizard and Golden Sun Moth

By applying the avoid, mitigate, and offset hierarchy to protect biodiversity within and around the Growth Areas, the City is ensuring impacts to biodiversity are reduced and key environmental values are protected.

Air quality, water resources, fire, hazards and risks

The Plan includes commitments to mitigate indirect impacts to biodiversity as a result of the Plan (as discussed above). These mitigation measures will help mitigate indirect impacts to current and future residents of the Growth Areas.

A number of impacts and risks are specifically associated with climate change. The Plan is considered to addresses significant vulnerabilities of climate change, particularly for biodiversity. This is because the Plan:

- Supports representativeness and replication of biodiversity by protecting and managing conservation areas within the Growth Areas and providing strategic offsets outside the Growth Areas
- Provides avoidance within the Growth Areas which focuses on the larger and more viable areas of biodiversity and applies a strategic offsetting approach outside of the Growth Areas
- Is not expected to disrupt habitat connectivity within the Strategic Assessment Area, and will contribute to this principle by avoiding and protecting connected areas of habitat within the Growth Areas
- Includes a number of measures to address potential indirect impacts (threats) under the Plan
- Incorporates adaptive management to ensure that outcomes are achieved efficiently and effectively

The way in which the Plan addresses climate change is discussed in detail in Part 5, Chapter 29.5 of the SAR.

In addition to mitigation measures under the Plan, further mitigation measures and management for the environment will be required as part of the Victorian planning system during the Plan's implementation. This includes:

- The Planning Policy Framework (PPF) which provides overarching policy to guide land use, subdivision and development in Victoria. Several policies under the PPF are relevant to the environmental management for the Growth Areas, including:
    - Clause 12.01 – aims to protect and enhance Victoria's biodiversity
    - Clause 12.03 – aims to protect and enhance river corridors, waterways, and wetlands
    - Clause 13.02 – aims to manage fire risks without unacceptable impacts to biodiversity
    - Clause 13.04 – aims to manage soil degradation and contaminated land
    - Clause 14.02 – aims to protect water quality
    - Clause 19.03 – aims to sustainably manage water through integrated water management
- Native Vegetation Precinct Plans (NVPPs) which provide for the strategic management of native vegetation within a precinct or other defined area. NVPPs identify the native vegetation to be retained, the native vegetation that can be removed, and the offset requirements for the native vegetation that can be removed
- Planning permits for subdivision and development that are consistent with the Greater Geelong Planning Scheme and generally in accordance with the relevant PSP that applies to the land. The planning permits process involves:
    - Preparation of technical studies and reports that support the application and inform the planning decision, including plans to address the potential impacts (environmental and socio-economic) of the development
    - Referral of the application to specialist referral authorities for advice and comment where required – these may object to the permit or specify conditions to be included on a permit to address potential impacts

- An opportunity for stakeholders to raise concerns and make submissions through a notification process
- Inclusion of conditions on permits to address the potential impacts of the development

Implementation through the Victorian planning system, in combination with commitments under the Plan, will help ensure there are no long-term negative impacts to air quality and water resources, and that existing or potential risks or hazards are adequately managed for current, future and nearby residents of the Growth Areas.

Access to natural spaces and visual amenity

Native vegetation within and surrounding the Growth Areas will be retained and protected as part of the Plan's conservation framework (as discussed above). These areas will provide increased visual amenity to future residents and visitors of the Growth Areas. Additionally, some of these natural spaces will be accessible to people. For example, Cowies Creek Conservation Area will include walking paths, cycling paths and picnic areas in combination with protection and management of the riparian areas. Access to these natural spaces will provide residents and visitors with areas to exercise and enjoy nature.

Community open spaces, including recreation reserves and local parks, will be integrated into the layout of the development areas, providing residents and visitors with access to these spaces for leisure and recreation, and adding visual amenity. Tree canopy cover will also be maximised in the Growth Areas to reduce urban heat, while also increasing visual amenity for the community. Optimising visual amenity may help attract new residents and businesses, and facilitate future investment opportunities and tourism in Geelong (The City of Greater Geelong, 2021b).

Conclusion

Protection and management of biodiversity is a key component of implementing the Plan that will help ensure environmental values are maintained and improved. Mitigation measures during implementation will ensure air and water quality, and the level of hazard or risk are not negatively impacted by the Plan.

Development and conservation under the Plan may also provide increased visual amenity and access to natural resources that could lead to positive socio-economic impacts for current, future and nearby residents of the Growth Areas.

26.3.7 THEIR HEALTH AND WELLBEING

MENTAL HEALTH

Mental health or behavioural problems in the Geelong region are modelled to occur in 11.7 per cent of males, and 15.2 per cent of females. This is higher than the Victorian state average for both males and females. Approximately 15.8 per cent of the population of Greater Geelong have experienced high or very high levels of psychological distress. Between 2010 and 2014, the Geelong region had a rate of suicide higher than the Victorian average (approximately 11.5 deaths per 100,000 population) (Geelong Region Alliance, 2019).

Community engagement is an important component of mental and physical health. Geelong has high rates of volunteering when compared to the Victorian average. Volunteering is more prevalent in older age groups, and females are more likely to volunteer with males (Geelong Region Alliance, 2019).

PHYSICAL HEALTH

Physical health is influenced by a large variety of factors. Healthy behaviours and disease vary in the Geelong region. When compared with the Victorian average, the Geelong region has (Geelong Region Alliance, 2019):

- Fewer smokers
- Better healthy eating habits
- More people getting a sufficient amount of exercise
- Higher levels of alcohol consumption

IMPACTS OF THE PLAN

Impacts to mental and physical health as a result of the Plan are difficult to accurately predict and there may not be any significant impacts. However, the environment is an important component of both the mental and physical health of the community. The Plan aims to protect and avoid key environmental values, mitigate negative impacts, and provide

aesthetic value and access the natural spaces (as discussed above). This may therefore positively impact the health and well-being of current, future and nearby residents of the Growth Areas.

26.3.8 THEIR PERSONAL AND PROPERTY RIGHTS

LAND USE CHANGE

Within the broader Geelong region, current land use includes primary production (62 per cent), national parks, natural water reserves, and conservation areas (24 per cent), and urban land (14 per cent) (Geelong Region Alliance, 2019).

The Strategic Assessment Area primarily includes land which has been developed for agricultural purposes. The NGGA is primarily used for pastoral and cropping activities, associated with rural residential housing. The WGGA includes a mix of existing land uses, including agriculture, recreation reserves, Council-managed reserves, rural and medium density housing, and educational facilities. While the WGGA does not contain any formal conservation reserves, there are a number of reserves managed by the City – including the Moorabool River Reserve (EHP, 2021).

IMPACTS OF THE PLAN

Land use change

To facilitate development and conservation under the Plan, the current composition of land use within the Growth Areas will change. The Urban Growth Zone (UGZ) under the Victorian planning system has been applied to the Growth Areas to manage the transition of non-urban land identified for urban growth into urban land. Within the UGZ, a PSP must be prepared before non-urban land can be converted into urban land. The PSP will detail the specific land-uses within portions of the Growth Areas.

Current land use consists of primary production with residents mostly living on rural properties. These residents and landowners within the Growth Areas will therefore be subject to changed land-use. Most of the current landowners will sell their rural properties to developers and the land will become urban land or conservation areas. This may have negative impacts to the current residents and landowners that live in a rural production environment and may not want to live in or be part of a more developed urban area. There will however be positive socio-economic impacts to new residents as the change in land use will provide them with new opportunities to live, work and play.

Although the change in land use may cause a negative impact to current landowners, they will also experience positive economic impacts due to the value of their land increasing and the opportunity to sell their land to developers.

26.4 CONSULTATION AND PROCEDURAL FAIRNESS

This section provides an overview of the relevant consultation processes that have taken place for the Growth Areas and those that have or will take place as part of the strategic assessment process and implementation of the Plan. It also explains how the strategic assessment process supports procedural fairness.

26.4.1 CONSULTATION

A number of consultation processes were involved in the identification and planning of the Growth Areas and development of the Framework Plan. Consultation has also been undertaken, or will be undertaken, during the strategic assessment process and during the Plan's implementation. The following sections provide an overview of the relevant consultation processes.

G21 AND IDENTIFICATION OF THE GROWTH AREAS

The G21 process and identification of the Growth Areas is discussed in Section 26.3.2

Development of the G21 documents involved consultation with State Government, peak bodies and environmental, community and business organisations of the region (Geelong Region Alliance, 2007). The G21 Region Plan was the primary document developed for the G21region alliance and involved an extensive consultation process which included (Geelong Region Alliance, 2007):

- More than 35 consultation forums to receive advice and opinions from various regional interest groups. The overall attendance of these forums almost reached 1,000 participants
- Releasing a first draft of the G21 Region Plan for stakeholder review and public comment

- Updating and revising G21 Region Plan based on the feedback received during consultation

FRAMEWORK PLAN

The Framework Plan for the Growth Areas is discussed in Section 26.3.2

Development of the Framework Plan involved in-depth consultation with the community and stakeholders. This included (The City of Greater Geelong, 2021b):

- 'Open House' community information sessions including:
  - A session to invite landowners to meet the project team and learn more about the project
  - Following the completion of technical studies another session took place to invite landowners to learn about the outcomes of draft technical studies that would inform the Framework Plan
  - Three concurrent sessions with landowners in in central Geelong, Corio and Batesford to discuss the draft future urban structure with the project team
- A 'Vision and Principles Workshop' with key stakeholders and landowners to develop the framework plan vision and set the principles for the future landscape in the Growth Areas
- 'Enquiry by Design' workshops where stakeholders and landowners discussed and developed a draft future urban structure for the Growth Areas
- A community feedback period (45 days) via online and written surveys. The community engagement undertaken as part of this process included:
  - Four open houses across the Geelong region that included more than 250 participants
  - Project brochures were sent to landowners
  - Multiple advertisements in the local newspaper
  - Circulation of 'community update' newsletters
  - Project information video posted to the City's Facebook and YouTube
  - 79 submissions were received relating to social, economic, and environmental concerns, and opposition or support of the Growth Areas
- Preparation of the Framework Plan included responding to community submissions

STRATEGIC ASSESSMENT PROCESS

Engagement to date

Consultation has been undertaken during the development of the Plan as part of the strategic assessment process. This included:

- An opportunity for stakeholder and community feedback on the draft ToR for the Strategic Assessment
- The first public exhibition process for the Strategic Assessment held from July to September in 2023. This included both the formal submission process, along with a series of online and in person information sharing sessions
- A number of stakeholder sessions throughout the project with DCCEEW, DELWP, and landholders to consult on:
  - The first and second round of Structured Decision Making for the NGGA in 2022 and 2024 (see Supporting Document C)
  - Potential funding mechanisms to deliver the conservation package

Future engagement

As part of the strategic assessment process under the EPBC Act there is a compulsory public consultation process where the strategic assessment documents (the SAR and the Plan) are published for public comment. As noted, this process was initially undertaken with the first round of documents in 2023. The revised 2025 documents have been prepared for a second round of public consultation (see Section 1.3 of Part 1 for further details).

Stakeholders and community members can submit submissions providing comments, concerns, questions or support as part of this process. The final strategic assessment documents are then prepared, taking any submissions into consideration. An additional submissions report will also be prepared that will detail how each of the submissions were addressed.

The City will undertake engagement in the lead up to and post public comment. Key stakeholder groups for consultation include:

- Corangamite Catchment Management Authority
- Environment groups
- Landholders
- The Australian Government Department of Climate Change, Energy, the Environment, and Water (DCCEEW)
- The Victorian Government Department of Environment, Land, Water and Planning (DELWP)
- The Wadawurrung Traditional Owners Aboriginal Corporation

The level and type of engagement with these groups will vary in accordance with their role in the Project.

Additionally, further consultation will be undertaken as part of the Plan's implementation. The Plan includes a commitment to develop a Stakeholder Engagement Strategy to guide engagement with key stakeholders on the implementation of the Plan (Commitment 22).

FUTURE PSP PROCESSES

Background and context

PSPs are high-level strategic plans that set out the preferred spatial location of land uses and infrastructure within each precinct, including details of the future urban structure of the precinct. This helps to stage development within an area and guide provision of subdivision permits, building permits and infrastructure delivery. Although PSPs provide a level of certainty for development, they are intended to be flexible to allow for site specific considerations.

The Framework Plan proposes the preparation of nine PSPs for the Growth Areas, of which six will be covered by the Strategic Assessment Area. The PSPs will be prepared sequentially as parts of the Growth Areas are released for development in accordance with a development release plan.

The City will prepare PSPs in consideration of the Framework Plan and the *Precinct Structure Planning Guidelines: New Communities in Victoria* (Victorian Planning Authority, 2021).

Consultation process

Consultation forms part of the PSP process which involves the following key steps:

- Early consultation with stakeholders to develop a vision for the precinct
- Preparation of technical studies and reports to understand key issues and constraints for the precinct, and to inform planning and management responses to be addressed in the PSP
- An opportunity for stakeholders to raise concerns and make submissions through public exhibition
- An independent planning panel hearing to consider and resolve key technical, planning and stakeholder issues
- Approval of the PSP and incorporation into the Geelong Planning Scheme through a planning scheme amendment

26.4.2 PROCEDURAL FAIRNESS

DEFINING PROCEDURAL FAIRNESS

Procedural fairness (also referred to as 'natural justice') requires fair and proper procedure to be followed when making a decision, to ensure a fair hearing and unbiased decision making. It typically applies to decisions that may negatively affect an interest of a person or corporation (Ombudsman Western Australia, 2019). Procedural fairness involves three main principles (Ombudsman Western Australia, 2019; James Cook University Australia, 2022):

- The right to be heard (also known as 'the hearing rule'): an opportunity is provided for the party to present information before a decision is reached that might adversely affect them
- The right to be treated without bias: any information presented should be considered without bias and the decision maker should be impartial and act without bias
- The decision is made based on relevant evidence: Any final decisions made should only consider evidence that is credible, reliable and sufficient to answer the critical questions. Irrelevant information or suspicion should not inform the decision

HOW THE STRATEGIC ASSESSMENT PROCESS PROVIDES PROCEDURAL FAIRNESS

The consultation process that forms part of the strategic assessment process under Part 10 of the EPBC Act (described in Section 26.4.1) provides potentially affected parties with procedural fairness. The way in which the consultation process supports each of the three main principles of procedural fairness is explained below.

The right to be heard

As part of the public comment period, submissions can be made by potentially affected parties before a final decision is made. These submissions need to be considered when preparing the final strategic assessment documents. A submissions report is also be prepared as part of this process, so that the potentially affected parties, other stakeholders and the Minister can understand how each of the submissions were addressed.

The right to be treated without bias

Any submissions received during the consultation process are considered without bias. The parties that are proposing or preparing the Plan must also disclose any conflicts of interest so that the decision maker (the Minister) is aware of any potential conflicts of interest when making the decision. The Minister must also make a decision without bias and disclose any potential conflicts of interest.

The decision is made based on relevant evidence

The Minister will make a decision on the Plan based on the relevant evidence provided as part of the strategic assessment process, including any submissions from potentially affected parties. This decision is made purely on the relevant, evidence-based information presented to the Minister and does not consider irrelevant information, suspicion, bias or unsubstantiated information.

References

AECOM (2021) 'Growling Grass Frog Strategy for Cowies Creek - 20 Evans Road, Bell Post Hill'.

AECOM (2025) 'Growling Grass Frog Conservation Management Plan'.

ALA (2025) 'Atlas of Living Australia'.

Alluvium (2022) 'Creamery Road Development Services Scheme Concept Design Report (Final)'.

Aurecon (2022) 'Vopak Victoria Energy Terminal - Terrestrial Flora and Fauna Assessment', *Prepared for Vopak Victoria Energy Terminal Pty Ltd* [Preprint].

Australian Bureau of Statistics (2022) *2021 Census*. Available at: https://www.abs.gov.au/census.

Australian Bureau of Statistics (2023) 'Regional Population Growth, Australia (3218.0)'.

Beacon Ecological (2009) 'Flora and Fauna Survey, for a Proposed Dam at Cowies Creek Reserve, 299 Anakie Road, Lovely Banks, Victoria. FINAL report July 2009 Luke Hynes and Annette Aboltins Attachment D'.

Beacon Ecological (2010) 'Cowies Creek Amphibian Survey and Targeted Growling Grass Frog (*Litoria raniformis*) Survey, Summer 2009-2010'.

Biosis (2023) 'Barwon Solar Farm: Flora and Fauna Assessment', *Prepared for Elgin Energy Pty Ltd* [Preprint]. Available at: www.biosis.com.au.

Biosis (2024a) 'Draft Growling Grass Frog Conservation Management Plan'.

Biosis (2024b) 'Victorian Grassland Earless Dragon, targeted surveys, and habitat suitability assessment - Geelong Growth Areas'.

Biosis & Open Lines (2024) *Victorian Grassland Earless Dragon Habitat Attribute Analysis*.

Birdlife International (2022) *BirdLife Data Zone*. Available at: http://datazone.birdlife.org/species/search.

Bradley, C.A. and Altizer, S. (2007) 'Urbanization and the ecology of wildlife diseases', *Trends in Ecology & Evolution*, 22(2), pp. 95–102.

CH2M Beca (2023) 'Parwan-Balliang Irrigation District Foundation Recycled Water Irrigation Areas-Stage 1 - Ecological Impact Assessment', *Prepared for Greater Western Water* [Preprint].

Clemann, N. and Gillespie, G. (2012) 'National Recovery Plan for the Southern Bell Frog *Litoria raniformis'*. Department of Sustainability and Environment.

Coleman, R.A., Hoffman, A.A. and Raaik, T.A. (2015) 'A review of *Galaxiella pusilla* (Mack) (Teleostei: *Galaxiidae*) in south-eastern Australia with a description of a new species', *Zootaxa*, 4021(2), p. 243. Available at: https://doi.org/10.11646/zootaxa.4021.2.2.

Commonwealth of Australia (2012a) 'Environment Protection and Environmental Offsets Policy', (October).

Commonwealth of Australia (2012b) 'How to use the offsets assessment guide'.

Commonwealth of Australia (2015) 'Wildlife Conservation Plan for Migratory Shorebirds'. Department of the Environment.

Commonwealth of Australia (2020) 'Wildlife Conservation Plan for Seabirds'.

Conservation Volunteers Australia (2022) *The Spit Nature Conservation Reserve - Avalon*. Available at: https://bookings.conservationvolunteers.org/project/the-spit-nature-conservation-reserve-avalon (Accessed: 19 July 2022).

Corangamite CMA (2014) 'Corangamite Waterway Strategy 2014 - 2022'.

CSIRO (1999) 'Urban Stormwater Best Practice Environmental Management Guidelines'. CSIRO.

DAWE (2020) 'National Recovery Plan for the Australian Fairy Tern (*Sternula nereis nereis*)'. Department of Agriculture, Water and the Environment.

DAWE (2021a) 'Conservation Advice for *Synemon plana* (Golden Sun Moth)'. Department of Agriculture, Water and the Environment.

DAWE (2021b) 'Finalised Priority Assessment List For The Assessment Period Commencing 1 October 2021'. Department of Agriculture, Water and the Environment.

DCCEEW (2022) *Species Profiles and Threats Database (SPRAT).*

DCCEEW (2023a) 'Conservation Advice for *Tympanocryptis pinguicolla* (Victorian grassland earless dragon)'.

DCCEEW (2023b) 'Conservation Advice for *Neophema chrysostoma* (Blue-winged Parrot)'.

DCCEEW (2023c) 'Draft National Recovery Plan for Four Grassland Earless Dragons (*Tympanocryptis* spp.) of Southeast Australia'.

DCCEEW (2024a) 'Conservation Advice for *Calidris acuminata* (sharp-tailed sandpiper)'.

DCCEEW (2024b) 'Conservation Advice for *Gallinago hardwickii* (Latham's Snipe)'.

DCCEEW (2024c) 'Conservation Advice for *Litoria raniformis* (Southern Bell Frog)'.

DCCEEW (2024d) 'FPAL assessment period commencing 1 October 2024'.

DCCEEW (2024e) 'National Recovery Plan - Spiny Rice-flower (*Pimelea spinescens ssp spinescens*)'.

DCCEEW (2024f) *Survey guidelines for four Grassland Earless Dragons (*Tympanocryptis *spp.) of Southeast Australia.*

DEECA (2024) 'Victorian Grassland Earless Dragon habitat distribution model'.

DELWP (2005) 'Native Vegetation - Modelled 2005 Ecological Vegetation Classes (with Bioregional Conservation Status)'. Department of Environment, Land, Water and Planning.

DELWP (2010) 'Victoria's regional centres – a generation of change'. Department of Environment, Land, Water and Planning.

DELWP (2017a) 'Growling Grass Frog Crossing Design Standards Melbourne Strategic Assessment'. Department of Environment, Land, Water and Planning.

DELWP (2017b) 'Growling Grass Frog Habitat Design Standards Melbourne Strategic Assessment'. Department of Environment, Land, Water and Planning.

DELWP (2017c) 'Growling Grass Frog Masterplan for Melbourne's Growth Corridors Melbourne Strategic Assessment'. Department of Environment, Land, Water and Planning.

DELWP (2017d) 'Habitat Importance Models'. Department of Environment, Land, Water and Planning.

DELWP (2018) 'Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site Management Plan'. Department of Environment, Land, Water and Planning.

DELWP (2019) 'Moolap Coastal Strategic Framework Plan'. Department of Environment, Land, Water and Planning.

DELWP (2020) 'Port Phillip Bay (Western Shoreline) & Bellarine Peninsula Ramsar Site Ecological Character Description'. Department of Environment, Land, Water and Planning.

DELWP (2022) 'Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site Boundary Review'.

Department of Jobs Precincts and Regions (2022) 'Coastal Acid Sulphate Soils'.

DEWHA (2008a) 'Approved Conservation Advice for the Natural Temperate Grassland of the Victorian Volcanic Plain'. Department of the Environment, Water, Heritage and Arts.

DEWHA (2008b) 'National framework and guidance for describing the ecological character of Australian Ramsar wetlands'.

DEWHA (2008c) 'Natural Temperate Grassland of the Victorian Volcanic Plain A nationally threatened ecological community'. Department of Environment, Land, Water and Planning.

DEWHA (2008d) 'Threat abatement plan for competition and land degradation by unmanaged goats'. Department of Environment, Water, Heritage and Arts.

DEWHA (2008e) *Threat abatement plan for predation by the European red fox*. Canberra, ACT: Dept. of the Environment, Water, Heritage, and the Arts.

DEWHA (2009a) 'EPBC Act Policy Statement 3.11 - Significant Impact Guidelines for the Critically Endangered Spiny Rice-flower (*Pimelea spinescens subsp. spinescens*)'. Department of Environment, Water, Heritage and Arts.

DEWHA (2009b) 'EPBC Act Policy Statement 3.14: Significant impact guidelines for the vulnerable Growling Grass Frog (*Litoria raniformis*)'. Department of Environment, Water, Heritage and Arts.

DEWHA (2009c) 'EPBC Act Policy Statement 3.14: Significant impact guidelines for the vulnerable Growling Grass Frog (*Litoria raniformis*) - Background Paper'. Department of Environment, Water, Heritage and Arts.

DEWHA (2009d) 'Significant impact guidelines for the critically endangered Golden Sun Moth (*Synemon plana*) - Nationally threatened species and ecological communities EPBC Act policy statement 3.12'. Department of Environment, Water, Heritage and Arts.

DEWHA (2010) 'Survey Guidelines for Australia's Threatened Frogs. EPBC Act survey guidelines 6.3'. Department of Environment, Water, Heritage and Arts.

DJCS (2023) 'Growling Grass Frog Spotlight Survey'. Department of Justice and Community Safety.

DoE (2013) *Matters of National Environmental Significance: Significant Impact Guidelines 1.1*. Canberra: Department of the Environment.

DoE (2014) 'Environmental Management Plan Guidelines 2014'. Commonwealth Department of the Environment.

DoE (2015a) 'Draft Referral guideline for 14 birds listed as migratory species under the EPBC Act'. Department of Environment.

DoE (2015b) '*Numenius madagascariensis* (Eastern Curlew) Conservation Advice', pp. 1–13.

DoE (2015c) 'Threat abatement plan for predation by feral cats'. Canberra.

DoE (2017) 'EPBC Act Policy Statement 3.21: Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species'. Department of Environment.

DoEE (2016a) *Threat abatement plan for competition and land degradation by rabbits*. Department of Environment and Energy, Canberra.

DoEE (2016b) *Threat Abatement Plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis*. Department of Environment and Energy.

DoEE (2017) *Threat Abatement Plan for predation, habitat degradation, competition and disease transmission by feral pigs (Sus scrofa)*.

DPE (2022) *Key Guidance - Amenity, NSW Planning Portal*. Available at: https://pp.planningportal.nsw.gov.au/major-projects/assessment/policies-and-guidelines/key-guidance/amenity.

DSE (2003) 'Biodiversity Action Planning: Strategic Overview for the Victorian Volcanic Plain Bioregion'. Victorian Government Department of Sustainability and Environment.

DSEWPaC (2011a) 'Nationally Threatened Ecological Communities of the Victorian Volcanic Plain: Natural Temperate Grassland & Grassy Eucalypt Woodland'. Department of Sustainability, Environment, Water Population and Communities.

DSEWPaC (2011b) 'Survey guidelines for Australia's threatened reptiles. EPBC Act survey guidelines 6.6'. Department of Sustainability, Environment, Water Population and Communities.

DSEWPaC (2013) '*Rostratula australis* (Australian painted snipe) Approved Conservation Advice'. Department of Sustainability, Environment, Water, Population and Communities.

DSEWPC (2011) 'EPBC Act - Referral guidelines for the vulnerable striped legless lizard, *Delma impar'*. Department of Sustainability, Environment, Water, Population and Communities.

EHP (2021) 'Existing Ecological Conditions: Northern and Western Geelong Growth Areas'. Prepared for the City of Greater Geelong.

EHP (2025) 'Preliminary Documentation: Residential Development at 200 Ballan Road, Moorabool, Victoria (EPBC 2023/09498)'.

Engage Victoria (2022) 'Port Phillip Bay and Bellarine Peninsula Ramsar Site Boundary Review'.

Gaertner, M. *et al.* (2017) 'Non-native species in urban environments: patterns, processes, impacts and challenges', *Biological Invasions*, 19(12), pp. 3461–3469. Available at: https://doi.org/10.1007/s10530-017-1598-7.

Geelong Field Naturalists Club (1969) 'Geelong naturalist : journal of the Geelong Field Naturalists Club', 6(2), p. 57.

Geelong Region Alliance (2007) 'The Geelong Region Plan'. G21 Geelong Region Alliance.

Geelong Region Alliance (2013) 'G21 Regional Growth Plan'. G21 Geelong Region Alliance.

Geelong Region Alliance (2014) 'G21 Region Economic Development Strategy'. G21 Geelong Region Alliance.

Geelong Region Alliance (2019) 'G21 Region Profile'. G21 Geelong Region Alliance.

Gordon, A. *et al.* (2011) 'Assessing the impacts of biodiversity offset policies', *Environmental Modelling & Software*, 26(12), pp. 1481–1488. Available at: https://doi.org/10.1016/j.envsoft.2011.07.021.

Gordon, A. and Peterson, I. (2019) *Cumberland Subregion Conservation Plan – Vegetation Trend Analysis*. Melbourne, Victoria.

Gregory, R. *et al.* (2010) *Structured Decision Making: A practical guide to environmental management choices*. Wiley-Blackwell.

Hansen, B.D. *et al.* (2016) 'Revision of the East Asian-Australasian Flyway Population Estimates for 37 listed Migratory Shorebird Species'. Unpublished report for the Department of the Environment. BirdLife Australia, Melbourne., p. 90.

Heard, G., Scroggie, M. and Clemann, N. (2010) *Guidelines for managing the endangered Growling Grass Frog in urbanising landscapes*. Citeseer.

Heard, G.W., Scroggie, M.P. and Malone, B.S. (2012) 'Classical metapopulation theory as a useful paradigm for the conservation of an endangered amphibian', *Biological Conservation*, 148(1), pp. 156–166. Available at: https://doi.org/10.1016/j.biocon.2012.01.018.

Howland, B.W.A. *et al.* (2016) 'Habitat preference of the Striped Legless Lizard: Implications of grazing by native herbivores and livestock for conservation of grassland biota', *Austral Ecology*, 41(4), pp. 455–464. Available at: https://doi.org/10.1111/aec.12337.

Informed Decisions (2022a) *City of Greater Geelong - Housing Monitor*. Available at: https://housing.id.com.au/geelong.

Informed Decisions (2022b) *Welcome to the City of Greater Geelong Community Profile*. Available at: https://profile.id.com.au/geelong.

James Cook University Australia (2022) *Procedural Fairness*.

Johnson, L., Bartel, R. and Mundell, M. (2020) 'Resilient Geelong: Reasons for success and challenges for a post-COVID-19 future'. Committee for Geelong.

Melville, J. *et al.* (2019) 'Taxonomy and conservation of grassland earless dragons: new species and an assessment of the first possible extinction of a reptile on mainland Australia', *Royal Society Open Science*, 6(5), p. 190233. Available at: https://doi.org/10.1098/rsos.190233.

Murphy, A. (2010) 'National Recovery Plan for Adamson's Blown-grass *Lachnagrostis adamsonii*'. Department of Sustainability and Environment.

Nature Advisory (2021) 'Summary of Flora and Fauna Assessment - Independent review of EHP report'.

Ombudsman Western Australia (2019) 'Procedural fairness (natural justice) - Guidelines'. Ombudsman Western Australia.

Parks Victoria (2022a) 'Barwon river estuary walk (Lake Connewarre Wildlife Reserve)'. Available at: https://www.parks.vic.gov.au/places-to-see/sites/barwon-river-estuary-walk.

Parks Victoria (2022b) 'Kirk point day visitor area (the spit wildlife reserve)'. Available at: https://www.parks.vic.gov.au/places-to-see/sites/kirk-point-day-visitor-area.

Parks Victoria (2022c) 'Limeburners Bay Wildlife Reserve (Limeburners Lagoon (Hovells Creek) Flora and Fauna Reserve)'. Available at: https://www.parks.vic.gov.au/places-to-see/sites/limeburners-bay-wildlife-reserve.

Parks Victoria (2022d) 'Lower Barwon River - Minah Street Day Visitor Area (Lake Connewarre Wildlife Reserve)'. Available at: https://www.parks.vic.gov.au/places-to-see/sites/lower-barwon-river---minah-street-day-visitor-area.

Parks Victoria (2022e) 'Lower Barwon River - Sheepwash (Lake Connewarre Wildlife Reserve)'. Available at: https://www.parks.vic.gov.au/places-to-see/sites/lower-barwon-river---sheepwash.

Parks Victoria (2022f) 'Striped Legless Lizard *Delma impar*'.

Parks Victoria (2022g) 'Taits point day visitor area (Lake Connewarre Wildlife Reserve'. Available at: https://www.parks.vic.gov.au/places-to-see/sites/taits-point-day-visitor-area.

Parks Victoria (2022h) 'The spit (Murcaim) (the spit wildlife reserve)'. Available at: https://www.parks.vic.gov.au/places-to-see/sites/the-spit-(murcaim).

Ramsar Convention (2005) 'Resolution IX.1 Annex A. A Conceptual Framework for the wise use of wetlands and the maintenance of their ecological character.'

Ratio (2022) *Geelong Residential Supply and Demand Assessment*. Available at: https://ratio.com.au/geelong-residential-supply-and-demand-assessment/.

Remplan (2022) *Our Place - Our Community*. Available at: https://app.remplan.com.au/geelong/community/summary?state=0V9yFwL9mSbQj1MIm0oWWzCktVtXVM (Accessed: 19 October 2022).

Robertson, P. and Evans, M. (2009) 'National Recovery Plan for the Grassland Earless Dragon *Tympanocryptis pinguicolla*'. Department of Territory and Municipal Services.

Rowe, D. (2021) 'About Corayo: A Thematic History of Greater Geelong'. The City of Greater Geelong.

Saddlier, S. and Hammer, M. (2010) 'National Recovery Plan for the Yarra Pygmy Perch *Nannoperca obscura*'. Department of Sustainability and Environment.

Saddlier, S., Jackson, J. and Hammer, M. (2010) 'National Recovery Plan for the Dwarf Galaxias *Galaxiella pusilla*'. Department of Sustainability and Environment.

Shahzad, H. *et al.* (2022) 'Characterizing the stormwater runoff quality and evaluating the performance of curbside infiltration systems to improve stormwater quality of an urban catchment', *Water (Switzerland)*, 14(1). Available at: https://doi.org/10.3390/w14010014.

Smith, W. and Robertson, P. (1999) 'National Recovery Plan for the Striped Legless Lizard (*Delma impar*)'. NSW National Parks & Wildlife Service.

SWIFFT (2022) 'Golden Sun Moth'. State Wide Integrated Flora and Fauna Teams.

Tactecol Consulting (2025) 'Growling Grass Frog Statement of Evidence: Creamery Road PSP (Cowies Creek)'.

The Breamlea Association (2016) 'Breamlea Fauna and Flora'. Available at: https://breamlea.com.au/main.asp?_=Flora and Fauna#Breamlea Flora Reserve.

The City of Greater Geelong (2016) 'catchments-city-of-greater-geelong'. https://www.geelongdataexchange.com.au/explore/dataset/catchments-city-of-greater-geelong/information/.

The City of Greater Geelong (2018) 'Municipal emergency management plan'.

The City of Greater Geelong (2020) 'Environment Strategy 2020–30'.

The City of Greater Geelong (2021a) 'Our Community Plan'.

The City of Greater Geelong (2021b) 'The Northern and Western Geelong Growth Areas Framework Plan.'

The City of Greater Geelong (2022a) *A clever and creative future*. Available at: https://www.geelongaustralia.com.au/clevercreative/default.aspx (Accessed: 2 November 2022).

The City of Greater Geelong (2022b) *Community profile*. Available at: https://www.geelongaustralia.com.au/geelong/article/item/8d4ada1a54c1202.aspx (Accessed: 20 October 2022).

The City of Greater Geelong (2022c) 'Domestic animal management plan 2022-2025'.

The City of Greater Geelong (2022d) *Employment and economy*.

The City of Greater Geelong (2022e) *Risks and Hazards for Geelong*.

TSSC (2003) 'Commonwealth Listing Advice on *Pimelea spinescens subsp. spinescens* (Plains Rice-flower, Spiny Rice-flower, Prickly Pimelea)'. Threatened Species Scientific Committee.

TSSC (2008) 'Commonwealth Listing Advice on Natural Temperate Grassland of the Victorian Volcanic Plain'. Threatened Species Scientific Committee.

TSSC (2016a) 'Conservation Advice *Delma impar* striped legless lizard'. Department of Environment and Energy.

TSSC (2016b) 'Conservation Advice *Pimelea spinescens subsp. spinescens'*. Department of the Environment and Energy.

TSSC (2016c) '*Limosa lapponica baueri* (Bar-Tailed Godwit (Western Alaskan)) Conservation Advice', (May), p. 15.

TSSC (2021) 'Conservation Advice *Prototroctes maraena* Australian Grayling'. Department of Agriculture, Water and the Environment.

US EPA (2022) 'Urbanization - Hydrology'.

Vanclay, F. *et al.* (2015) 'Social Impact Assessment: Guidance for Assessing and Managing the Social Impacts of Projects'. International Association for Impact Assessment.

Victoria State Government (2017) 'Plan Melbourne 2017-2050'.

Victorian Planning Authority (2021) 'Precinct Structure Planning Guidelines: New Communities in Victoria'.

Visit Victoria (2022) 'History and heritage'. Victoria State Government.

Vranjic, J. (2008) 'Natural Temperate Grassland of the Victorian Volcanic Plain: A Nationally Threatened Ecological Community', *Australasian Plant Conservation: Journal of the Australian Network for Plant Conservation*, 17(2), pp. 42–43. Available at: https://doi.org/10.3316/informit.890724278584362.

Wadawurrung Traditional Owners Aboriginal Corporation (2020) 'Paleert Tjaara Dja - let's make Country good together 2020 - 2030 - Wadawurrung Country Plan'.

Weller, D. *et al.* (2020) 'Australian National Directory of Important Migratory Shorebird Habitat'. Prepared for the Department of Agriculture, Water and the Environment by Birdlife Australia.

Zoos Victoria (2024) *Victorian Grassland Earless Dragon Conservation Action Plan*.