Securing the Southern Metapopulations of the Growling Grass Frog in the Merri Creek

Prepared by the Merri Creek Management Committee in collaboration with:

MERRI CREEK MANAGEMENT COMMITTEE

Melbourne Water

Merri-bek City Council

HUME CITY COUNCIL

City of Whittlesea

VICTORIA State Government | Energy, Environment and Climate Action

Acknowledgement of Country

The Merri Creek Management Committee proudly acknowledges the Wurundjeri Woi-wurrung People of the Kulin Nation as the traditional custodians of the land of the Merri Merri. We pay our respects to Elders past and present.

We recognise the Wurundjeri Woi-wurrung People's ongoing connection and stewardship of the land of the Merri Merri and its ecosystems.

This strategy includes objectives and actions that aim to see the Wurundjeri Woi-wurrung continue their ongoing engagement with and care for this Country.

Photograph: Bruce McGregor
Front page photograph: Dr Geoff Heard

Vision

The Growling Grass Frog is regularly heard and seen throughout the Merri Creek and its tributaries from Somerton to Fawkner. Land and water managers, scientists and Traditional Owners collaborate to ensure the sustainability of this species. Local communities and visitors enjoy the environment and help care for this iconic frog.

Goals

For the area covered by the Strategy:

- Within 10 years the Strategy area (Somerton – Fawkner) will see a 20% increase in sites occupied by the Growling Grass Frog from 2024 levels[1].
- Within 10 years there will be 20% more off-stream Growling Grass Frog wetland area[2] than in 2024[1]. Within 20 years there will be a 40% increase.
- We will not lose any of the breeding populations as identified in 2024[1].

1. 2024 levels refers to information that is known about occupation data for the Growling Grass Frog in 2024. For many locations this will mean reference to Geoff Heard's 2022 survey data.

2. Refer to page 22 for current areas of off-stream wetland habitat. From the analysis, 20% more wetland area would require 9.7ha and 40% would be 19.4ha.

Front page photograph credit: Department of Environment, Energy, and Climate Action

Photo Credit: Dr Geoff Heard

Table of Contents

Page 7	**1.**	**Introduction**
Page 10	**2.**	**Strategy Purpose and Structure**
Page 10	2.1	Purpose
Page 10	2.2	Structure
Page 11	**3.**	**Part A - Strategy Implementation**
Page 13	3.1	Strategy Implementation
Page 14	**4.**	**Part B - On-Ground Priorities**
Page 14	4.1	Priority Maps
Page 15	4.2	Implmentation of On-Ground Projects
Page 22	4.3	Securing and Enhancing GGF Breeding Habitat Locations
Page 28	4.4	Creating and Improving Habitat Links
Page 32	4.5	Enhancing Terrestrial Habitat
Page 34	4.6	Stormwater Wetlands
Page 36	**5.**	**Part C - Supporting Priorities**
Page 36	5.1	Managing Stormwater and Water Quality
Page 38	5.2	Groundwater – Feeding the Ecosystem
Page 39	5.3	Predatory Fish and Crustacea
Page 41	5.4	Engaging Communities and Neighbours
Page 42	5.5	Ongoing Monitoring and Maintenance Team
Page 43	5.6	Addressing Knowledge Gaps
Page 44	**6.**	**References**

Glossary

Barriers

Human structures that reduce the capacity for dispersal and population connectivity, either through habitat or the intervening matrix.

- Primary barriers: Considered to be complete barriers to dispersal, being urbanised land (houses or industrial buildings in adjacent lots) and major arterial roads.
- Secondary barriers: Considered to be weaker barriers to movement, encompassing bitumen roads and rail-lines (Heard, G. pers comm 2022).

Breeding population location

Locations where the GGF has been observed to be successfully breeding as evidenced by the presence of tadpoles and metamorphs often in consecutive years. These locations have been identified mainly via Geoff Heard's studies, and in some locations confirmed via extra survey episodes.

Breeding habitat – ideal characteristics

Still or slowly-flowing water that supports calling, egg-laying, egg incubation and larval development, encompassing open water and beds of emergent, submergent and floating vegetation.

Buffer

An area of land surrounding a habitat feature for Growling Grass Frogs (DELWP 2017a).

Chytrid fungus

Bactrachochytrium dendrobatidis, a parasitic fungus of amphibians. It spreads within water and moist environments (DELWP 2017a).

Chytridiomycosis

An infectious disease of amphibians, caused by chytrid fungus (DELWP 2017a).

Colonisation

The process by which a species establishes a new population in an unoccupied environment (DELWP 2017a).

Connectivity

The degree to which a corridor, network or matrix of wetlands is connected for Growling Grass Frogs. In practice, this usually refers to the capacity for physical movement, or gene-flow for the species, through the landscape (DELWP 2017a).

Connectors

Human structures that enable dispersal through barriers, including bridges and wet culverts (Heard, G. pers comm 2022).

Dispersal (of GGF)

The movement of Growling Grass Frogs through the landscape. Especially relates to movements between one key habitat and another, such as between waterbodies and between aquatic and terrestrial micro-environments (DELWP 2017a).

Emergent vegetation

Aquatic plants that are rooted below the water surface and with foliage emergent above the water-surface (Heard et al. 2010)

Foraging habitat – ideal characteristics

Aquatic and terrestrial zones, encompassing aquatic vegetation, open terrestrial areas (bare ground; patchy, low grasses), rocks, rock piles and the waterline (Heard, G. pers comm 2022).

Habitat (for the GGF)

Any standing water body or section of a stream that holds water at least periodically for a period of 2 months or longer, encompassing the high-water mark and surrounding 100 m of the terrestrial zone. A breeding population may or may not be present (Heard, G. pers comm 2022).

Habitat protection

The preservation of existing populations of GGF within a 1 km radius of the focal population/s, by preserving and maintaining the wetlands in which they occur (Heard et. al. 2010).

Habitat enhancement

The improvement of existing wetlands close to the focal population/s so that they can be colonised by GGF and support additional neighbouring populations. An example is the enhancement of farm dams, which are numerous across the range of the species but are frequently unoccupied because of short hydroperiods or poor aquatic vegetation cover. However, habitat enhancement need not be restricted to the improvement of artificial wetlands such as farm dams; it includes enhancing pools along streams, creeks, and other drainage lines (Heard et. al. 2010).

Habitat creation

The construction of purpose-built wetlands for GGF near focal population/s, so that they can be colonised and support additional populations. This option primarily entails the construction of wetlands to be filled by surface run-off, drainage diversions or pumping. Although the construction of pools along ephemeral streams or drainage lines may be considered habitat creation, it is really a form of habitat enhancement because it essentially involves enhancing the hydroperiod of an existing wetland (Heard et. al. 2010).

Habitat region

An area formerly containing a known metapopulation, where suitable habitat still exists for the species.

Hydroperiod

The length of time or season in which a wetland holds standing water. Definitions of hydroperiod (from Table 1 Heard et al. 2010 p. 5):

- Ephemeral - Fills and dries out annually with average rainfall.
- Semi-permanent - Fills and dries out annually, or at some other interval, according to rainfall.
- Permanent – Never dries out, regardless of rainfall (DELWP 2017a)

Intervening matrix

Areas of non-urbanised land that do not fit the definition of habitat but through which dispersal can occur, encompassing grassland, shrubland, parkland and farmland (Heard, G. pers comm 2022).

Linking habitat

The area between habitat (for the GGF), as defined above, which provides the ability for GGF to move (disperse) between such habitat. The linking habitat itself may not meet habitat criteria but nevertheless it has some habitat characteristics and the potential to be improved such that it supports GGF to survive and disperse.

Metapopulation

A set of discrete populations of a species that are connected by migration (Hanski 1999 in Heard et al 2010).

Offline wetland

A wetland that is not connected hydrologically to an existing stream or drainage network (DELWP 2017a)

Overwintering habitat

Vegetation at the waterline, soil cracks, and rocks, rock piles and fallen timber in the terrestrial zone (Heard, G. pers comm 2022).

Sheltering habitat

Aquatic and terrestrial vegetation, soil cracks, and rocks, rock piles and fallen timber in the terrestrial zone (Heard, G. pers comm 2022).

Terrestrial habitat

Habitat for Growling Grass Frogs that is located away from the wetland margin. This may include areas well away from open water in which they forage, shelter (for example over winter) or move between waterbodies (DELWP 2017a).

Underpass

A type of wildlife crossing structure that aims to allow fauna (in this case the GGF) to cross beneath a human-made barrier, normally a road or railway line, safely.

1. Introduction

The Merri Creek Management Committee (MCMC), in partnership with land managers, species experts and other Merri Creek stakeholders, has developed this Growling Grass Frog (GGF) Strategy for an area that includes sections of the Merri Creek, Central Creek and Edgars Creek corridors in the northern suburbs of Melbourne from Somerton/Epping in the north to northern Fawkner/Reservoir in the south. This area is approximately 2,400 hectares and is shown in Figures 1a and 1b. The area to which this Strategy applies deliberately excludes most of the Merri Creek GGF Conservation Areas which were designated under the Melbourne Strategic Assessment (MSA) and are subject to the *Biodiversity Conservation Strategy for Melbourne's Growth Corridors* (DSE 2013) and *Growling Grass Frog Masterplan for Melbourne's Growth Corridors* (DELWP 2017a).

This Strategy seeks to conserve several metapopulations of the GGF (Figure 1a), aiming to ensure their ongoing sustainability in the face of development pressure now and in the coming decades. The GGF is listed as Vulnerable both under the federal *Environment Protection and Biodiversity Conservation Act 1999* and the Victorian State *Flora and Fauna Guarantee Act 1988*. In recent years there has been an alarming decline in the Merri/Edgars populations (see *Securing the Growling Grass Frog Southern Metapopulation in the Merri Creek Background and Issues Paper* (MCMC 2022) for more information).

The locations of the existing GGF habitat within this landscape vary from relatively natural waterway and wetland habitat through to constructed stormwater wetlands, dams, and quarry holes. Similarly, the land uses in which habitat is found range from conservation reserves to industrial sites and include active quarries and former landfill sites.

For the purpose of this Strategy, four metapopulations and one GGF habitat region are recognised (Figure 1a), these being:

- Southern Metapopulation;
- Barry Road Metapopulation;
- Merri and Central Creek GGF Habitat Region;
- O'Herns Road Metapopulation[3]; and
- Edgars Creek Metapopulation.

These names are associated with roads or localities that are known by local land managers and ecologists, so are used for ease of communication. Each of the metapopulation areas has currently known breeding populations. The Merri and Central Creek GGF habitat region is recognised as formerly sustaining a breeding population but the most recent record for this area was in 2011. This area still includes suitable GGF wetland habitat and is linked to two waterways which may act as dispersal corridors (the Merri and Central Creeks). It is also located centrally within the Strategy area, hence its inclusion.

An urgent initial focus for the development of this Strategy was the urban development around a former quarry site in Bolinda Road Campbellfield where there is a resident, breeding GGF population.

During the development of this Strategy (2021-2024), there have been four industrial developments come to the final planning stages that threaten important GGF habitat and other resident GGF populations. The entire Strategy area is seeing many of its final areas of private land being urbanised, restricting options for future GGF habitat and threatening current habitat. This highlights the importance of well-informed pre-planning and strategic advice to secure the habitat requirements for the GGF and to ensure linkages with surrounding waterways and populations are factored in as early as possible. It is intended that this Strategy will be used to support better planning and habitat outcomes for the GGF.

The Strategy has been informed by a process of research and guided by a Project Steering Group. This Steering Group was made up of staff from public land managers and authorities: Hume City Council, City of Whittlesea, Merri-bek City Council, Melbourne Water, Parks Victoria, Department of Energy, Environment and Climate Action (DEECA); plus the Merri Creek Management Committee in a coordinating role. GGF expert and academic researcher, Dr Geoff Heard provided technical support and expertise to the project team and the Project Steering Committee. The project also engaged with a number of private landholders whose land provides habitat for GGF.

3. This metapopulation straddles the area of this Strategy and the area incorporated into the MSA GGF Conservation Area.

The Strategy applies to lands and waters that are the traditional Country of the Wurundjeri Woi-wurrung people. Cultural engagement occurred during the development of this Strategy and will continue to be an important feature in the implementation of the Strategy.

For further detail on the background information that has guided this strategy, please refer to the document *Securing the Growling Grass Frog Southern Metapopulation in the Merri Creek Background and Issues Paper* (MCMC 2022).

Figure 1(a). Strategy area with four metapopulation areas and one habitat region shown

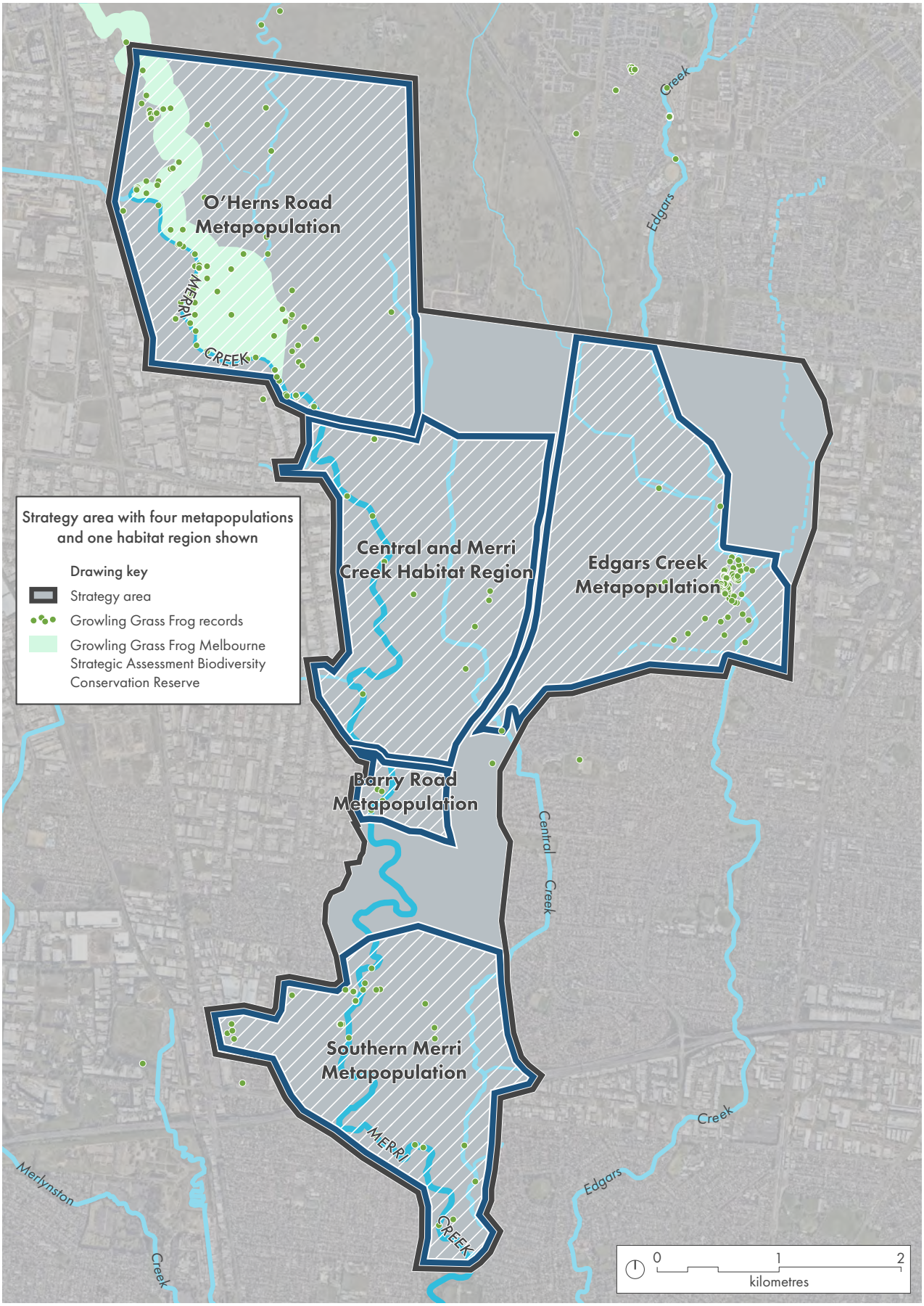


Figure 1(b) - Strategy area

2. Strategy Purpose and Structure

2.1 Purpose

The purpose of this Strategy is to provide high-level guidance to local and regional land managers to assist in directing and prioritising actions to see the southern meta-populations of the GGF within the Merri catchment secured within the next ten years.

The objectives of this Strategy are to:

- Identify priority locations for management and conservation; enhancement and linking habitats as well as for further investigative work.
- Provide high-level guidance on a range of supporting actions that can be undertaken as funding sources or opportunities are identified.
- Be a source of future project ideas for applications to funding bodies and a guide to assist in supporting collaborative effort between stakeholders.
- Be a point of information that will assist in raising the profile of the plight of the GGF within the Strategy area.

The Strategy does not intend to be a detailed action plan and its implementation will rely on collaborative activity by land managers, driven by a coordinating body of stakeholders. There is no single source of funding to deliver the recommended actions or infrastructure although there are some sites that are managed for conservation by local authorities. For example, the City of Whittlesea's northern quarries site, 605 O'Herns Road – a conservation area under the Melbourne Strategic Assessment (MSA); galada tamboore, bababi marning and galgi ngark among other important pieces of land managed by councils, Parks Victoria, and Melbourne Water. It is hoped that this document and the collaboration that it aims to foster will see increased funding allocated by land managers and funding opportunities pursued by stakeholder partners from grants, philanthropic sources and elsewhere.

2.2 Structure

This Strategy is divided into three parts.

Part A – Strategy Implementation

Part A describes how the Strategy is intended to be implemented.

Part B - On-Ground Actions

Part B focusses on specific on-ground actions, linked to the 4 metapopulation areas and one habitat region for the GGF within the Strategy area. These on-ground priority actions are shown in Maps 1-5. Relevant objectives and actions relating to breeding areas, linking habitat, terrestrial habitat and stormwater wetlands are provided.

Part C – Supporting Actions

This section provides objectives and actions aligned with general themes relevant to the entire Strategy area and in some cases, extend further afield. Brief background information is provided for each theme as well as a summary table containing objectives and actions.

Figure 2. Merri Creek looking south from O'Herns Road crossing, Somerton

3. Part A - Strategy Implementation

Strategy Implemetation Group

The relationships between managers of GGF habitat in the region have strengthened through the development of this Strategy by the Project Steering Group. It is intended that the implementation of the Strategy will be coordinated by a similar 'Strategy Implementation Group' the members of which will work collaboratively to meet the goals and objectives of this Strategy. The continuation of these engagement processes will help to ensure the success of this Strategy and see positive outcomes for the GGF within the Strategy area.

This Strategy has been informed by a review of documents that are particularly relevant to GGF management, land and water management and cultural heritage values. Part of the Strategy area sits within the southern section of the marram baba Merri Creek Regional Parklands. This GGF Strategy aims to align with the *marram baba Merri Creek Regional Parklands Future Directions Plan* as well as other strategies that apply to the Strategy area. Details of most of these are provided in Appendix 1 of the *Securing the Growling Grass Frog Southern Metapopulation in the Merri Creek Background and Issues Paper* (MCMC 2022).

Funding

Funding for many of the actions within the Strategy is as yet, unknown. Upfront funding for new wetland habitat projects suggested in this Strategy will be needed, as well as for any one-off action items; however, the larger consideration will be the resources needed for ongoing maintenance of any conservation 'assets' such as constructed wetlands. Although there is not yet a clear path for funding, it is envisaged that this Strategy will provide a focus for relevant stakeholders to consider directing funding towards relevant action items or to seek funding from grants, philanthropic sources and elsewhere. It is also intended that this Strategy will serve as the starting point for an ongoing program for improved awareness and knowledge about the GGF and its requirements in urban settings.

Note: For all Priority and Supplementary Actions in this strategy, unless otherwise stated, it is intended that the Strategy Implementation Group will seek options to implement the action. This may involve a collective approach, or it may be appropriate for just one or a few organisations to lead the implementation once a plan for the relevant action has been set.

Action Plan

This strategy has a notional duration of 10 years. The majority of the goals are linked with 10 years with one also providing an indicative 20 year figure.

It is envisaged that in order to implement priority actions, the Strategy Implementation Group will develop a suitable 'Action Plan' to guide the activities of the group in shorter-term intervals. The Action Plan may include tasks that are required to achieve a longer-term goal as well as shorter-term goals, like education or engagement outcomes. The duration of the Action Plan will be determined by the Steering Group and may take into account budget or funding cycles of various member groups. It is envisaged that the duration of each Action Plan may be for intervals of between 1-3 years as appropriate and its success towards achieving the overall goals, and objectives of the Strategy will be monitored throughout and documented. The results of each subsequent Action Plan will be used to guide future action plans.

A process diagram showing how the action planning may work is shown in Figure 3.

Periodic Strategy Review

This Strategy will be subject to an iterative review process, nominally every three years with the opportunity for updates to its objectives and actions, should the Strategy Implementation Group identify that this is warranted. Figure 3 shows how the iterative 3-yearly review of the strategy may be undertaken and how it would sit alongside an annual planning process.

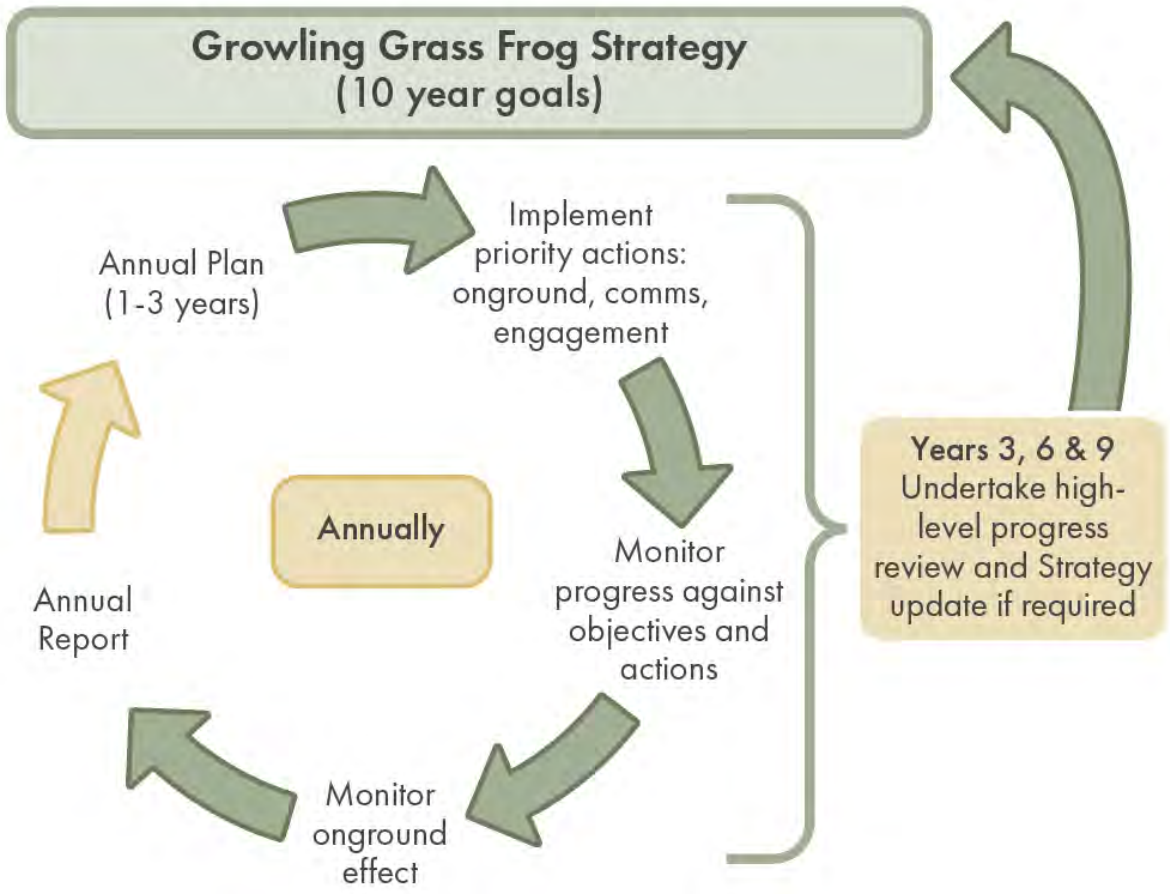


Figure 3. Process for planning and review of implementation efforts for this Strategy

3.1 Strategy Implementation

Objectives and actions

Objective	Action	Priority / Timeline
O1 Establish a Steering Group to focus on achieving the objectives of this strategy.	**A1.1** Formalise the Strategy Implementation Group and its membership to work together with the aim of achieving the objectives and monitoring the delivery of this Strategy. Include: City of Whittlesea, Hume City Council, City of Darebin and Merri-bek City Council, Melbourne Water, Parks Victoria, DEECA and the Merri Creek Management Committee; the Wurundjeri Woi-wurrung and private landholders if there is interest and availability from these groups; appoint a GGF scientific expert as an advisor to the group. Develop a Terms of Reference for the Strategy Implementation Group.	High priority Within six months of the Strategy release
O2 Continue to seek appropriate and timely Indigenous cultural engagement	**A2.1** Ensure appropriate and timely engagement with the Wurundjeri Woi-wurrung in the Strategy Implementation Group. This may include the involvement of the Narrap Team in some projects.	As appropriate, in accordance with direction from the Wurundjeri Woi-wurrung Cultural Heritage Aboriginal Corporation
	A2.2 Ensure that all on-ground or planning projects that result from this Strategy include sufficient up-front budget for adequate engagement with the Wurundjeri Woi-wurrung and where required, for Cultural Heritage Management Plan provisions	Ongoing, for every relevant project
O3 Seek opportunities for upfront and ongoing funding to support this Strategy	**A3.1** Members of the Strategy Implementation Group to seek opportunities within their organisations (where relevant) as well as externally via grants or other sources to deliver priority elements of the Strategy, including creation of wetland habitat and its ongoing maintenance.	High priority and ongoing focus for the Steering Group

4. Part B - On-Ground Priorities

The following table provides information on the prioritisation process for on-ground effort and guidance for when further prioritisation decisions are required.

Priority	Detail
Highest Priority	Secure existing breeding habitat. • These are locations with recognised breeding populations. • In the priority maps, these are shown as 'breeding habitat'. • Breeding locations in private ownership are the highest priority for developing positive owner/land manager relationships.
Secondary Priority To be determined on a case-by-case basis. Considering: • GGF values; and • opportunities or constraints associated with the implementation of relevant actions.	Increase area of breeding habitat (wetland surface), with high hydroperiod (deep, permanent water options) and anti-chytrid properties (warm, saline, with rocky areas; and no shading). Introduce linking habitat, giving priority to locations where there is potential or existing isolation of a breeding population. Explore opportunities for GGF reintroduction where there is existing, unpopulated habitat.
Other Priorities	On-ground activities that are not directly related to breeding habitat. These include improvement of instream habitat or terrestrial habitat adjoining instream environments.

4.1 Priority Maps

The following maps contain a range of options within the four metapopulation areas and one habitat region. They are largely the outcome of a Technical and On-ground Expert workshop held in November 2021 and form the basis of future on-ground works for conservation of the GGF in the Strategy area. These priority areas and actions may change as circumstances alter and further information comes to hand.

Note: the priority maps, as well as any associated objectives and actions should be reviewed and updated every 3 years at a minimum by the Strategy Implementation Steering Committee.

4.2 Implementation of On-Ground Projects

As this Strategy is intended as a guidance document the on-ground works identified in the priority maps, such as new wetland areas, the supporting actions in Part C, have not yet been subject to in-depth planning processes.

Any on-ground works projects will be subject to appropriate scoping, due diligence and planning processes and will seek the involvement of all relevant stakeholders in their planning and implementation. This will include as a minimum, consideration of:

- Indigenous cultural heritage values information
- Cultural heritage management planning under the *Aboriginal Heritage Act 2006*
- Ecological values including flora, fauna, native vegetation and habitat values and requirements under the *FFG Act 1988, EPBC Act 1999, Wildlife Act 1975, Planning and Environment Act 1987* and *Catchment and Land Protection Act 1994*
- Geological, geomorphological, hydrological and hydrogeological considerations
- Other heritage values, or historical information
- Geographic or topographic limitations
- Geotechnical assessment
- Investigation into suitable water supply options for GGF habitat ponds
- Land use or land management constraints
- Site contamination assessment
- Ongoing maintenance arrangements especially for constructed assets
- Possible funding sources including for ongoing management.

Figure 4. Old River Red Gum on Merri Creek, North Park Drive Nature Reserve, Somerton

Legislative Requirements

All land managers, including public land managers are guided in their obligations to conserve threatened species, including the Growling Grass Frog via state and federal legislation.

Environment Protection and Biodiversity Conservation Act, 1999

At the federal level this includes the Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act).

Under the EPBC Act, actions that are likely to have a significant impact on a matter of national environmental significance are subject to rigorous referral, assessment, and approval processes. An action includes a project, development, undertaking, activity, or series of activities. The EPBC Act protects matters of national environmental significance. Civil and criminal penalties may be imposed for breaches of the EPBC Act. The GGF is listed as Vulnerable under the EPBC Act. Additionally there are other flora, fauna and ecological communities that are listed under the EPBC Act and require similar consideration.

Online resource: General information on the EPBC Act

Online resource: Specific information relating to the GGF under the EPBC Act

Both links from the Department of Climate Change, Energy, the Environment and Water.

Flora and Fauna Guarantee Act 1988

At the state level the Flora and Fauna Guarantee Act 1988, (FFG Act) is the key piece of Victorian legislation for the conservation of threatened species and communities and for the management of potentially threatening processes. The Act's objectives are to protect, conserve, restore and enhance biodiversity.

The FFG Act requires that in performing any of their functions that may reasonably be expected to impact on biodiversity, including a function under any act, ministers and public authorities must give proper consideration to the Act's objectives, so far as is consistent with the proper exercising of their functions.This provides an added requirement for public authorities including local, state and federal government organisations to not only take action 'for' the conservation of the GGF, but also to not act in a way or undertake works that will further threaten the status of the GGF.

Additional matters are also specified to be considered to clarify the objectives, including the State Government's Biodiversity Strategy, relevant action statements, management plans or critical habitat determinations.

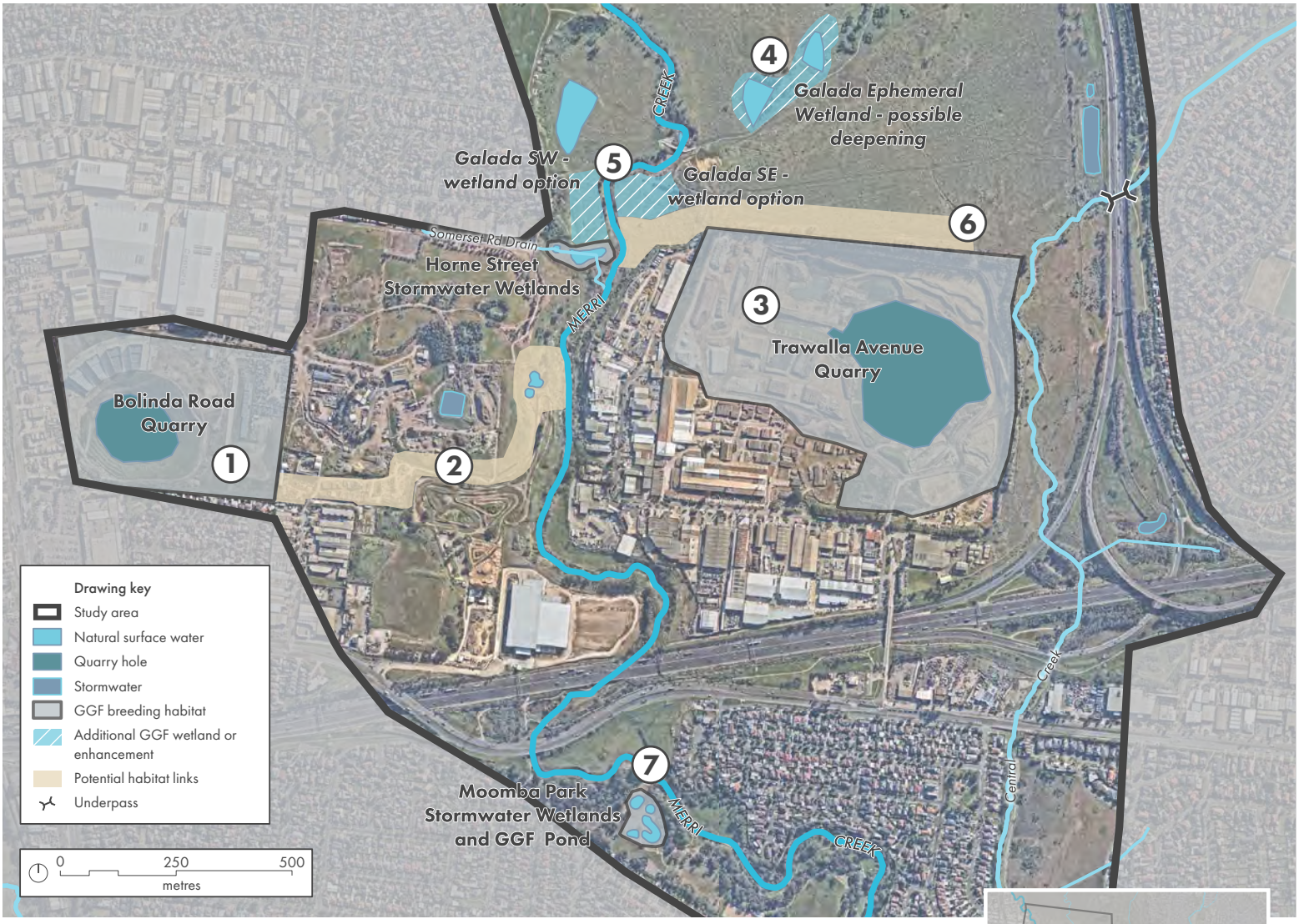
The types of potential impacts on biodiversity that should be considered are also specified, these include:

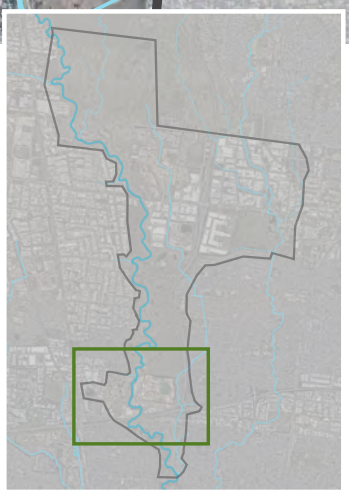
- long and short term impacts
- detrimental and beneficial impacts
- direct and indirect impacts
- cumulative impacts
- potentially threatening processes.

The Act establishes tools to provide guidance to public authorities in considering biodiversity. Further information on the 'public authority duty' can be found at the Department of Energy, Environment and Climate Action's website.

Specific information on the State Government Action Statement for Growling Grass Frog is available here.

Map 1. Southern Metapopulation – Potential Priority Areas for GGF Conservation Actions





1 **Priority** – A former quarry with GGF Breeding Habitat. Site of an approved development. Quarry hole is to be retained but terrestrial habitat significantly reduced and population potentially isolated.

Refer to O4, A4.1 - 4.4; O10, A10.1 and A10.2

2 **Priority** – support Hume City Council in the establishment of an effective GGF link from Bolinda Road Quarry to Merri Creek

The former Bolinda Road Quarry supports a breeding population and is under threat of isolation because of surrounding development that will curtail GGF migration options.

The alignment shown in this map is indicative with final plans to be developed in collaboration with the Hume City Council.

Refer to O12, A12.1.1 and 12.1.2

3 **Priority** – An operating quarry with GGF Breeding Habitat. Continue engagement with the owners.

Refer to O4, A4.1 - 4.4; O8, A8.1; O10, A10.1 and A10.2

4 Option for deepening this currently ephemeral wetland

Note: Any pre-planning should investigate potential past rubbish or machinery dumping, including asbestos.

Refer to O7, A7.1

5 Possible locations for new dedicated GGF wetlands (Galada SW and Galada SE) to augment existing habitat.

Note: Nearby Horne Street stormwater wetlands are unsuitable as potential water source

Wetlands should sit above 1:100-year flood level

Refer to O6, A6.1 and O17, A17.4

6 Option to augment habitat adjoining Trawalla Ave Quarry, via a habitat link with the Merri Creek.

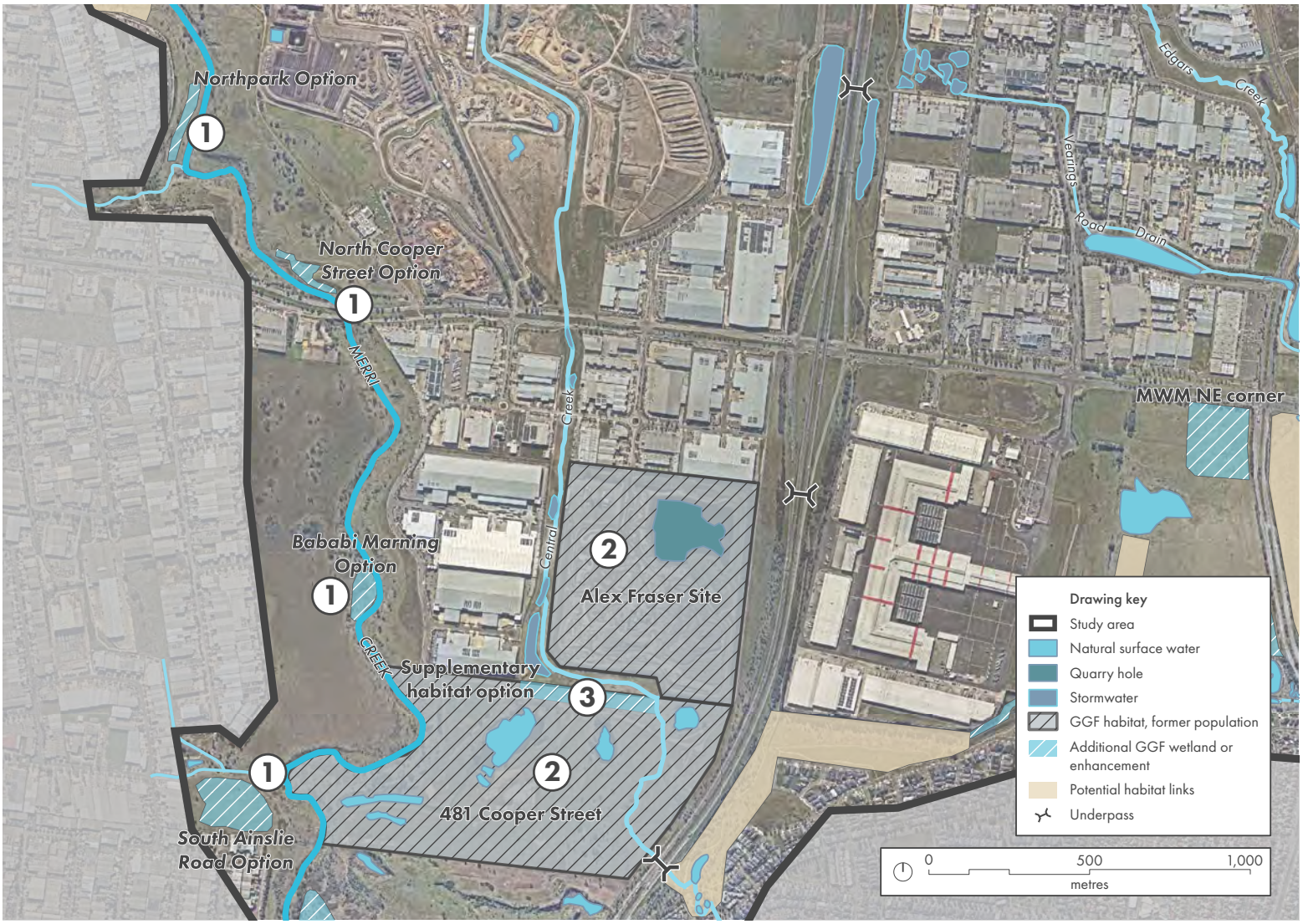
An eastern extension of this link to Central Creek may be warranted should evidence become available to suggest GGF migrate to Central Creek from the Quarry.

Refer to O12, A12.2

7 Investigate whether there is a link between the Fawkner population south of the Ring Road and the populations to the north of the Ring Road

Refer to O30, A30.1

Map 2. Central and Merri Creek GGF Habitat Region – Potential Priority Areas for GGF Conservation Actions



① Possible locations for new dedicated GGF wetlands to augment existing habitat.

Note: Wetlands should sit above 1:100-year flood levels.

Due diligence ecological and cultural heritage assessments will inform viability of each option.

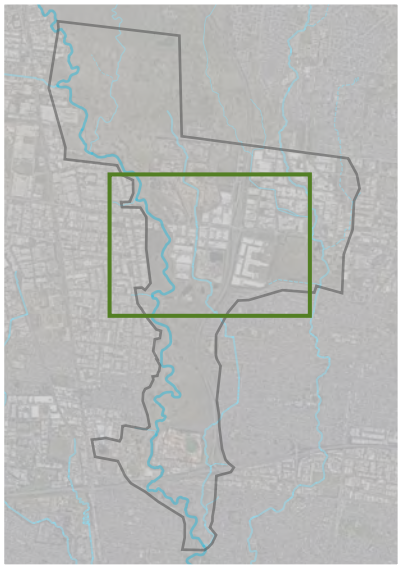
Refer to O6, A6.1

② Potential future options to investigate return of GGF to wetlands with high habitat values on these two sites.

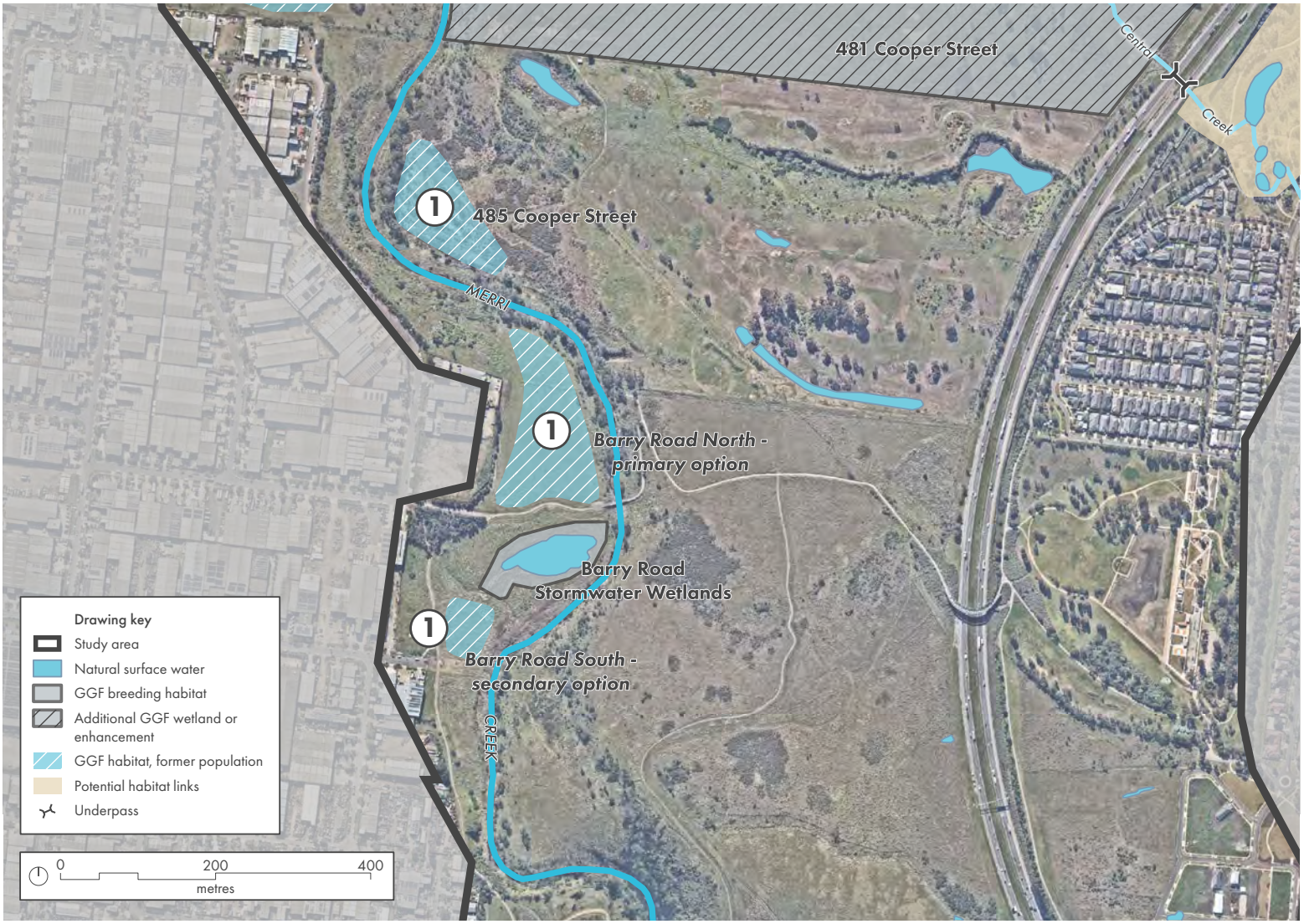
Refer to O11, A11.1-A11.3

③ Option to improve an attempted GGF habitat corridor via widening significantly and improving habitat value.

Refer to O13, A13.1, A13.2



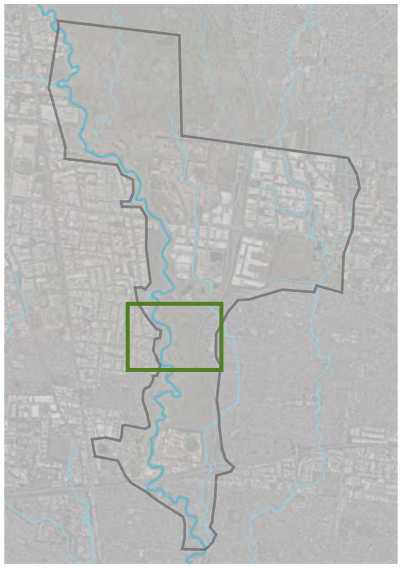
Map 3. Barry Rd Metapopulation – Potential Priority Areas for GGF Conservation Actions



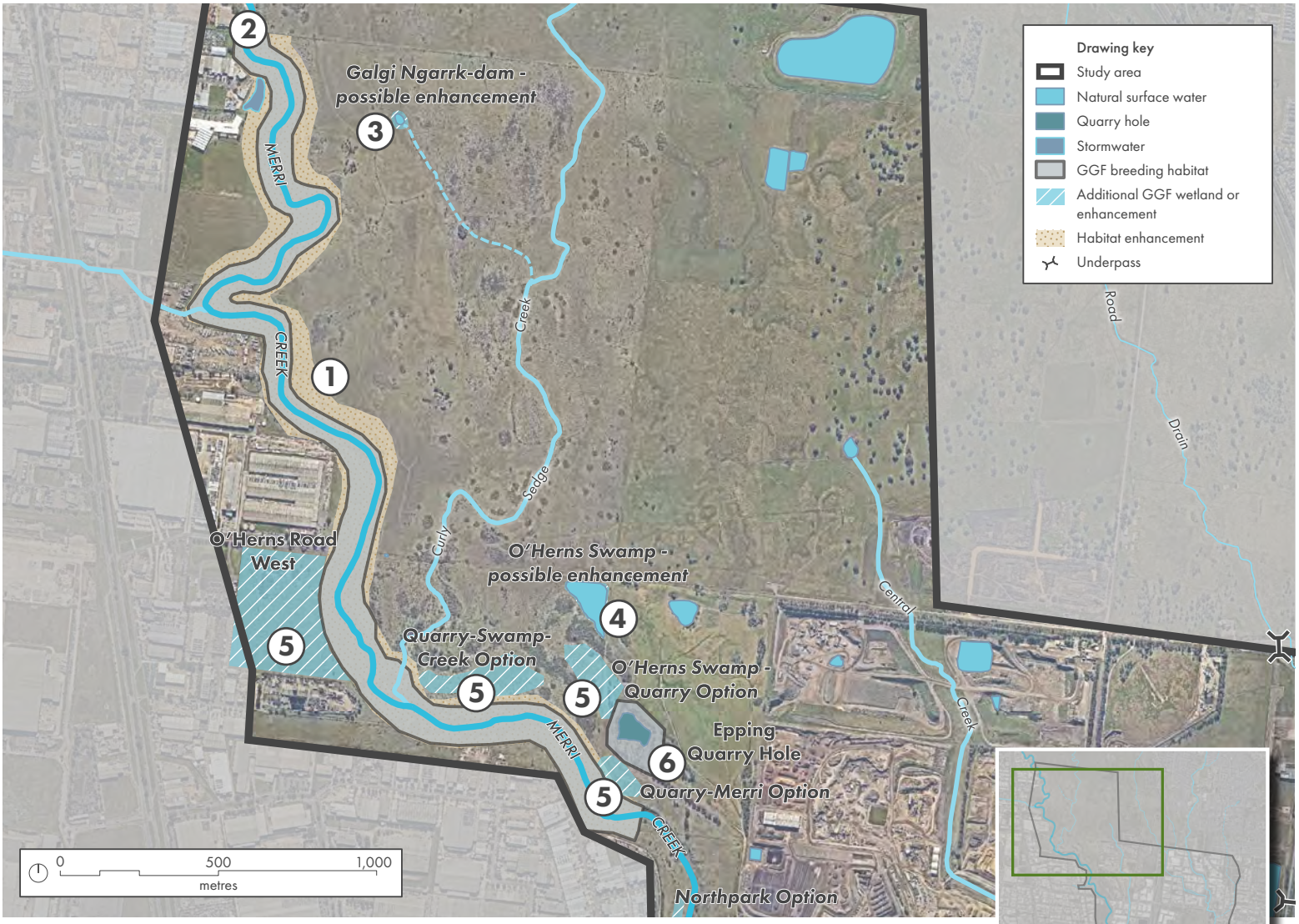
(1) Possible locations for new dedicated GGF wetlands to augment existing stormwater habitat.

Note: Wetlands must sit above 1:100-year flood levels.

Refer to O6, A6.1 and O17, A17.4



Map 4. O'Herns Metapopulation – Potential Priority Areas for GGF Conservation Actions



1 O'Herns Priority Reach Breeding Habitat Location:

Hawthorn and gorse have been problematic along the creek, shading the waterway and adjoining habitat, favouring conditions for Chytrid fungus.

North of O'Herns Road, a few episodes of woody weed work have occurred.

Opportunities for targeted carp removal in pools upstream of O'Herns Road may assist especially after large rain events.

Refer to O14, A14.1-A14.4

2 Flows from Yarra Valley Water's Craigieburn Sewage Treatment Plant, to the north, may have been important in retaining GGF habitat in Merri Creek through Millenium Drought.

Ensure future management does not disadvantage the GGF population downstream.

Refer to O9, A9.1

3 Due to its proximity with in-stream populations in the Merri Creek, it may be beneficial to investigate this site for potential habitat enhancement.

Refer to O7, A7.1

4 Option to deepen (or partially deepen) O'Herns Swamp to provide more reliable wetland habitat in dry seasons. Or to provide additional water to increase reliability of wetland habitat.

Important to note: Native vegetation constraints are present and will need to be considered as part of any project evaluation, including records of the Nationally Vulnerable River-swamp Wallaby-grass, *Amphibromus fluitans*.

Refer to O7, A7.1

5 Possible locations for new dedicated GGF wetland habitat to augment existing habitat.

Note: Wetlands should sit above 1:100-year flood levels.

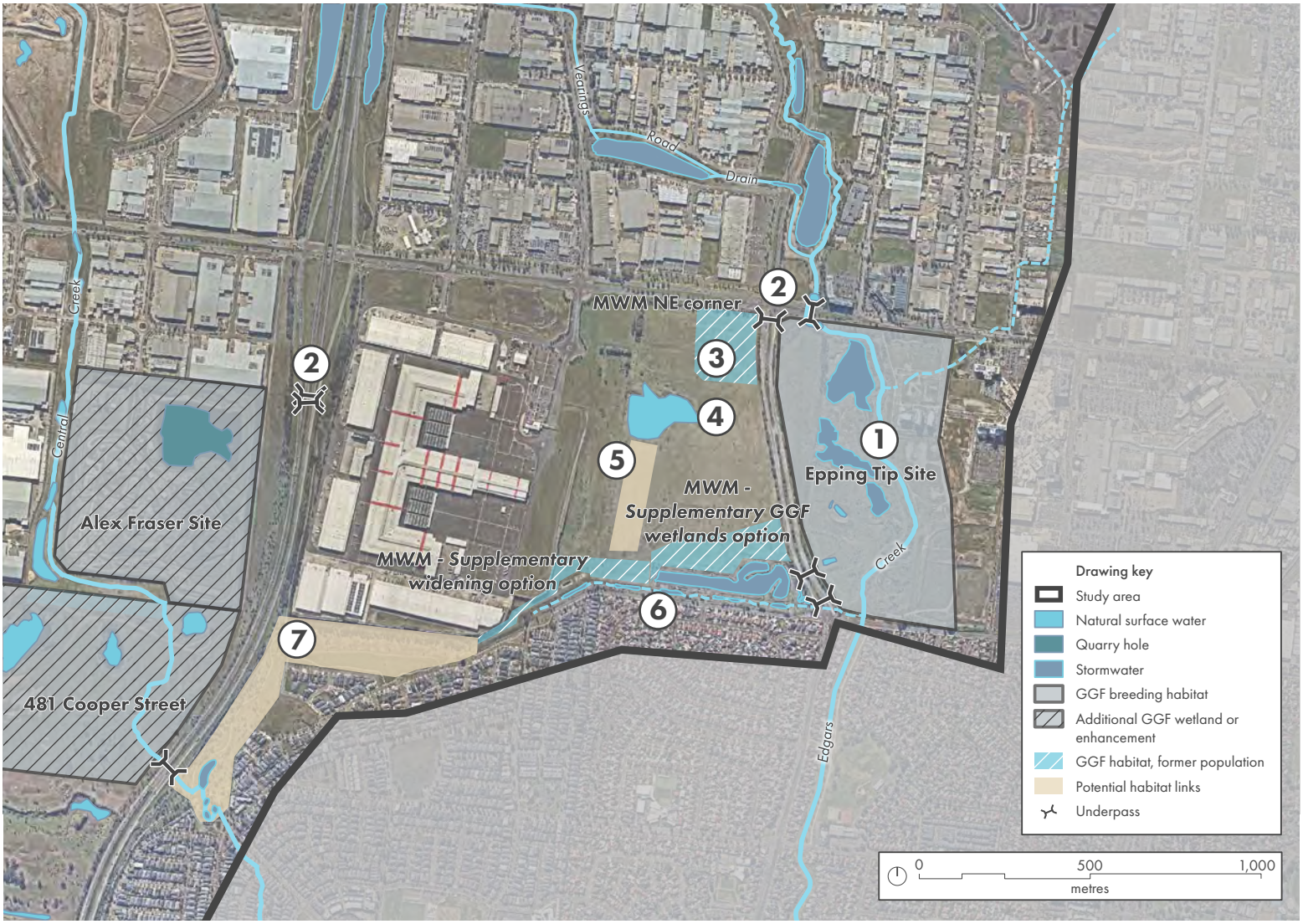
Refer to O6, A6.1

6 Whittlesea's Epping Quarry Hole management plan identifies management of wetland vegetation and needing somewhere to pump excess water to.

Adjoining new wetlands (such as the Quarry-Merri Option) could provide a solution.

Refer to O5, A5.1

Map 5. Edgars Road Metapopulation – Potential Priority Areas for GGF Conservation Actions



1 **Priority** – A former quarry and landfill site with GGF Breeding Habitat. Site of an approved development. This will see important GGF habitat removed, some created and significant development across the majority of the site, threatening the current breeding population.

Refer to O4, 4.1 - 4.4; O10, A10.1 & A10.2

2 **Knowledge gaps:** Determine the effectiveness (or lack of) underpasses with road authorities, and research the habitat values that sit to the north and south of Cooper Street along Edgars Creek.

Refer to O30, A30.1

3 Possible location for new dedicated GGF wetlands to augment existing habitat.

Refer to O6, A6.1

4 **Knowledge gap:** Confirm plans for Melbourne Wholesale Market east land and status of GGF within the wetlands and supplementary habitat on this land. Current values include an ephemeral wetland (former shallow quarry). Options for augmenting this include GGF wetlands in the north-east corner, linking habitat to the south and options for widening the current, narrow wetland habitat along the southern boundary.

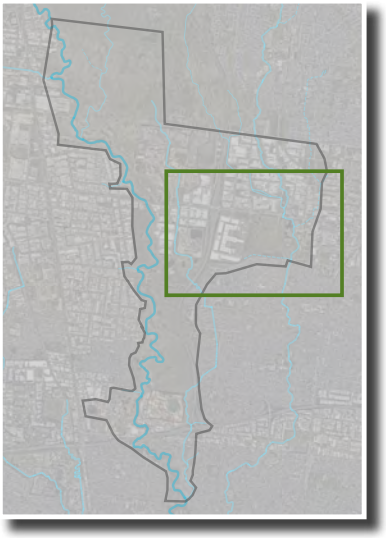
5 Option for widening this linking habitat area.

Refer to O7, A7.1

6 Linear wetlands: Concerns have been raised regarding size, hydroperiod and vegetation structure of existing wetlands along southern boundary of this site.

Seek opportunities to monitor and assess effectiveness. Widen and enhance if possible.

Refer to O13, A13.1 & A13.2



7 Carlingford Triangle link: City of Whittlesea has a capital works plan for steppingstone wetlands to link with the existing wholesale market linear wetlands. Is a 50m pinch point between VicRoads land and residential roads.

Refer to O12, A12.2

4.3 Securing and Enhancing GGF Breeding Habitat Locations

The population of the GGF within the Strategy area has been monitored for 20 years as part of a long-term study undertaken by Dr Geoff Heard and colleagues. This monitoring dataset shows that the population was relatively stable up until recently, but surveys conducted in the 2021-22 season suggest that it is in decline. The past three years have seen wetter La Niña conditions and this appears to have resulted in lower occupancy within the Strategy area, particularly in Merri Creek in-stream locations. This is consistent with other findings that suggest wet seasons tend to result in lower occupancy rates in in-stream sites, and that the GGF appears not to return to former population levels when conditions become drier. This is concerning as these Merri Creek instream sites may not recover. However, separately to Dr Heard's study, the GGF is now being annually recorded at near-stream locations in the Merri Parklands in Fawkner, a location where it has not been recorded for some decades. In addition, a couple of off-stream locations such as O'Herns Swamp recorded GGF in the 2021-22 season.

The overall trend in decline is undoubtedly linked to the increased urbanisation seen within the Strategy area in the past 20 years (see Figure 5). While the extent of this urbanisation may stabilise within the next 5-10 years as the final areas of private land are developed, impacts from upstream development will continue for decades to come. This is highly likely to degrade instream habitat further and render it unsuitable for GGF breeding, particularly affecting the O'Herns Road Metapopulation and potentially the Southern Metapopulation.

As a result of the likely permanent loss of important instream GGF breeding habitat, off-stream habitat will increase in importance, particularly for breeding. Instream habitat will remain important for connection and dispersal, but not as breeding habitat. On this basis it is vitally important to ensure that off-stream breeding and linking habitat is accessible to instream habitats, particularly to instream locations that are known to support GGF populations such as in the vicinity of O'Herns Road.

Wetland habitat area

Analysis of mapped wetland areas shows that the Strategy area (2,400 ha) currently contains approximately 2% surface area of wetlands of all types (see Table 2 below). Of these, only 30% are known to support breeding habitat. Of the 13 ha of quarry hole habitat, the habitat at Bolinda Road and at 215 Cooper Street, Epping (former Epping Tip) which represents almost half of the quarry habitat (5.3 ha), is facing development scenarios which may see the populations impacted in the near future.

One of the three goals for this Strategy involves ensuring no breeding populations are lost. Another pertains to ensuring that no currently occupied sites are lost and the third relates to seeing an increase in GGF habitat area. Within 10 years the goal is a 20% increase in GGF habitat area. Achieving this would require creation of an additional 9.7 ha of GGF habitat. The 20-year goal would require another 9.7 ha created in the following 10 years.

Table 2. Mapped wetland types within the Strategy area

Wetland type	Area (ha)	% Strategy area	Area breeding habitat (ha)	% Strategy area supporting breeding habitat
Natural or surface water (including dams within conservation reserves)	6.7	0.28%	1.4	0.06%
Quarry hole (deep and shallow)	19.2	0.8%	12.9	0.54%
Stormwater or constructed wetlands (including those constructed as supplementary habitat for GGF, with no proven success)	22.6	0.95%	0.7	0.03%
Totals:	**48.5**	**2.03%**	**14.9**	**0.62%**

Operating quarry holes with GGF present

There is one currently operating quarry which is known to support a breeding population of GGF and there is the potential that GGF may occupy other actively operating quarries in the future. Where GGF habitat occurs in quarries which operate under a Works Agreement, it is important to ensure that rehabilitation plans for these sites do not destroy the GGF habitat. For example, at Bolinda Road application of the EPBC Act 1999 overrode a Victorian Works Agreement which required site rehabilitation that would have seen the quarry hole filled in. A pro-active approach is required to ensure other populations are not jeopardised via similar processes.

Improved environmental protections for locations with GGF

The trajectory of recent development approvals for sites that contain existing GGF breeding habitat highlights the need for improved environmental protections. Approvals for development have generally been provided on a site-by-site basis without consideration of the cumulative impact on the GGF within the region. Examples include a sequence of three developments along Merri Creek south of Cooper Street, Epping: 'Biodiversity Park' (formerly 475 Cooper St), and 481 and 485 Cooper Street, Epping. While the properties are adjacent to each other, they have been assessed separately without an integrated plan for protecting and linking GGF habitat. The impact of this is exacerbated by growth further north in the catchment, which is degrading instream habitat for the GGF within the Strategy area.

Development approvals that require protection and/or creation of new GGF habitat to replace removed habitat require close oversight to ensure the delivery of intended GGF outcomes is achieved.

Furthermore, guidelines which were developed by the State Government for the purpose of setting standards for GGF wetland habitat construction and enhancement, as well as for suitable fauna crossings, are not incorporated into any formal planning policy for areas outside the Melbourne Strategic Assessment (MSA) area. This Strategy recommends the use of these guidelines as a minimum standard. They are regularly recommended for use in developments by government departments and authorities. However, when tested at VCAT for the New Epping development[4] (at Epping Tip site - Map 5) it was determined that these guidelines only formally apply in MSA areas.

In the northern part of the Strategy area, GGF Conservation Areas have been designated through the MSA process. All are on public conservation land and are identified through the Environmental Significance Overlay (ESO) 6 of the Whittlesea Planning Scheme. A number of known GGF breeding habitats south of the MSA area, along Merri Creek and on public land, are covered by a Merri Creek ESO. Whilst comprehensive, this ESO does not specifically mention GGFs.

Known GGF breeding habitats on privately owned land within the Strategy area are not recognised via planning controls. Approved development plans may provide assurance for the time being at some sites, but there still remains the question of longer-term protection and the understanding of the purpose of GGF reserves and linking habitat, once development is fully realised. A number of known GGF breeding sites have no protection via the planning scheme. This is something that could be remedied through the application of a relevant planning control, such as the Environmental Significance Overlay, the schedule of which could draw specific attention to GGF values and conservation needs.

4. Riverlee Caruso Epping Pty Ltd v Whittlesea CC [2022] VCAT 1166 (10 October 2022), para 59

Figure 5. Aerial images of the Strategy area in July 2002 (left) and 2022 (right) showing the change in the extent of urban development, primarily industrial, over the 20-year period

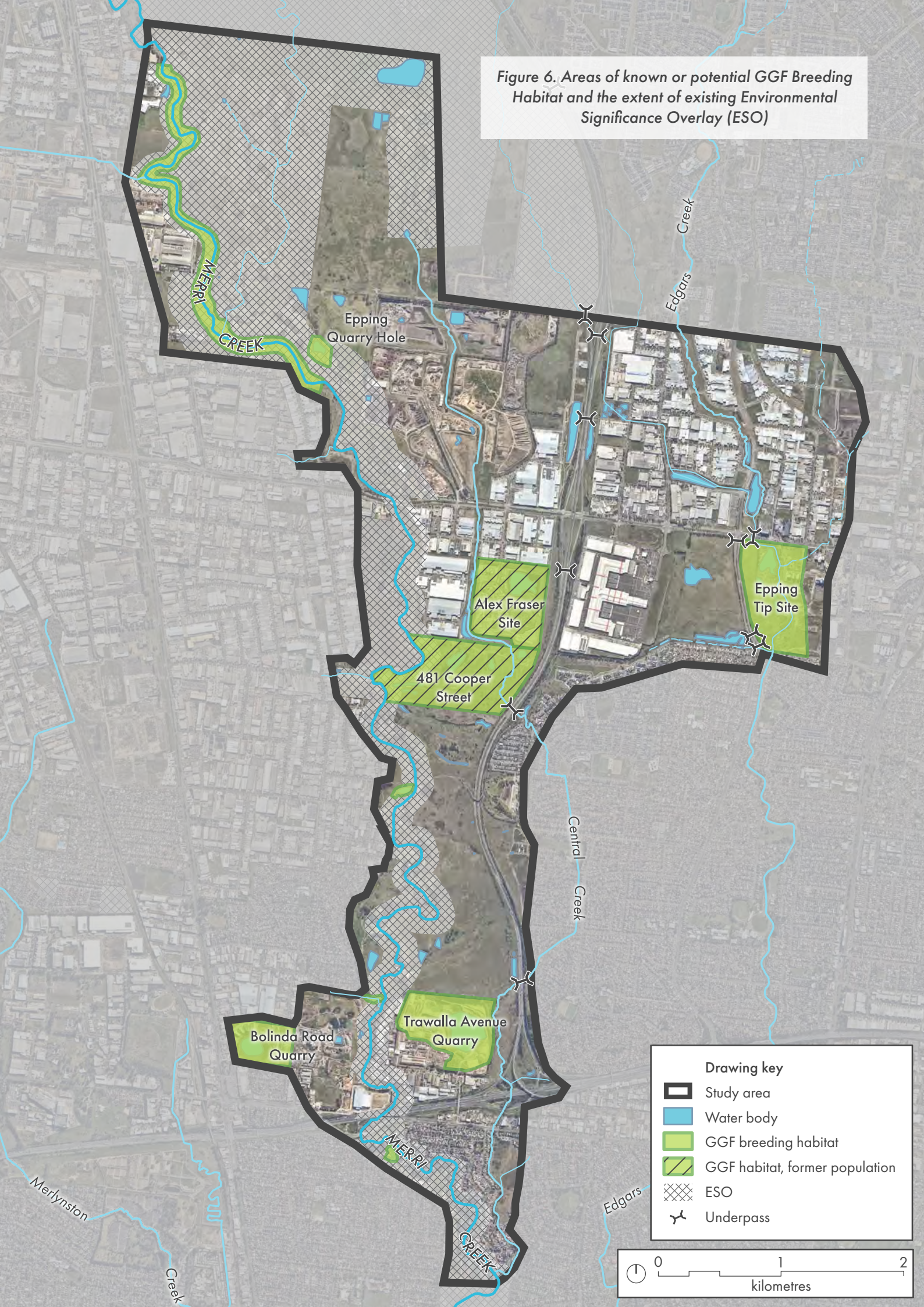


Figure 6. Areas of known or potential GGF Breeding Habitat and the extent of existing Environmental Significance Overlay (ESO)
MERRI CREEK
Epping Quarry Hole
Edgars Creek
Alex Fraser Site
Epping Tip Site
481 Cooper Street
Central Creek
Trawalla Avenue Quarry
Bolinda Road Quarry
MERRI CREEK
Merlynston Creek
Edgars
Drawing key
Study area
Water body
GGF breeding habitat
GGF habitat, former population
ESO
Underpass
0
1
2
kilometres

Objectives and Actions – Securing and Enhancing GGF Breeding Habitat Locations

Objective	Actions	Priority and timeframe
O4 Continue seeking to secure breeding habitat locations under private management and ownership.	A4.1 MCMC, DEECA and local authorities: Continue to engage in planning processes in response to development proposals as relevant. A4.2 Seek constructive relationships with the owners and managers of each area. A4.3 Through partnerships with relevant authorities, seek regular (annual if possible) monitoring of each breeding habitat location and monitoring of appropriate management. A4.4 Seek to support private land managers with access to advice from a GGF expert, especially at times of potential land management and land use change.	High priority Ongoing
O5 Support public land managers of breeding habitat locations.	A5.1 Support public land managers, including local government, with assistance as needed and seek complementary projects when opportunities arise, for example through grants or other funding programs	High priority As required and as opportunities arise.
O6 Increase the area of off-stream GGF habitat, particularly in the vicinity of breeding habitat locations.	A6.1 Utilising the 'priority maps' (Maps 1- 5) identify delivery options for new and improved habitat close to GGF breeding habitat locations.	High priority 20% increase in habitat within 10 years and 40% within 20 years.
O7 Improve GGF habitat quality, particularly of breeding habitat locations.	A7.1 Utilising the 'priority maps' (Maps 1- 5) local land managers and authorities seek funding to improve the quality of GGF wetland habitat within and/or close to GGF breeding habitat locations. Examples may include increasing depth, hydroperiod, water source, vegetation enhancement, terrestrial habitat enhancement. Note: Habitat enhancement is not intended for stormwater wetlands	Medium priority. One project within 5 years.
O8 Ensure the sustainability of any GGF populations within operating quarry holes within the Strategy area once operations cease.	A8.1 Seek options to update Works Agreements for operating quarries which harbour GGF populations to ensure Agreements do not require 'filling in' or compromising any GGF habitat areas. Engage with appropriate authorities and land managers.	High priority Within three years

Objectives and Actions – Securing and Enhancing GGF Breeding Habitat Locations

Objective	Actions	Priority and timeframe
O9 Ensure that the closure of the Craigieburn Treatment Plant does not jeopardisethe instream GGF O'Herns Road metapopulation.	A9.1 Engage with Yarra Valley Water to ensure the plans for ceasing discharge from the Craigieburn Treatment Plant do not jeopardise the O'Herns Road GGF metapopulation located downstream from the current outfall.	High priority Within one year
O10 Seek improved planning controls for the protection of important GGF locations.	A10.1 Investigate options for strengthening planning controls for important locations for the GGF within the Strategy area. This may include addressing gaps in the extent of overlays, updated schedules to overlays, appropriate zoning or other mechanisms.	Medium priority Within 3 years
	A10.2 Incorporate recognition of important GGF habitat locations and links into relevant management plans and biodiversity strategies or similar, where relevant/required and as the opportunity arises.	Ongoing activity of the Strategy Implementation Group
O11 Once breeding habitat locations are secure, seek options for GGF reintroduction into suitable habitats.	A11.1 Scope options for reintroduction of GGF to locations within the Strategy area where habitat is favourable. Sites known to have formerly had populations and that have retained habitat to some extent include the Alex Fraser Quarry and 481 Cooper Street.	Low priority Mid-long term once breeding habitat elsewhere has been secured and populations in those locations are considered stable.
	A11.2 Implement reintroductions if suitable habitat and ethical translocation arrangements have been arranged.	
	A11.3 Seek to monitor GGF numbers and breeding success annually.	

Figure 7. City of Whittlesea's Northern Quarries site

4.4 Creating and Improving Habitat Links

Priority locations for habitat links are shown in Maps 1-5. Of these, the Bolinda Road link in Campbellfield (Map 1) is the highest priority as it aims to link the high-quality, known breeding habitat at the former Bolinda Road Quarry with the Merri Creek. A preliminary concept design for this link is provided in Figure 9.

Other proposed habitat links generally align with the secondary prioritisation category as the breeding habitat they link is not currently under direct threat of isolation (for example that which adjoins the PGH Quarry in Trawalla Ave, Thomastown – Map 1) or they do not directly link known breeding habitat (for example within and south of the Melbourne Wholesale Market site, Epping – Map 5).

In addition to the links described above, a habitat link is part of an approved development plan for 481 Cooper Street, Epping (Map 2). This is intended to include some GGF habitat works along the northern boundary of the site and to some extent along Central Creek which runs throughout the site. Stakeholders involved in negotiations related to this proposal have advocated for positive conservation outcomes for this area, including GGF habitat considerations. There may need to be further habitat enhancement work undertaken in the future once the development is finalised.

Wetlands that are located within links and any supplementary habitat need to be suitable for breeding.

In addition to larger wetlands, which will always be an important element of linking and provision of supplementary habitat for breeding habitat locations, smaller or stepping stone wetlands will need to be included. DEECA's habitat design standards address the design requirements for larger wetlands, but at present there is little guidance information available for the design of smaller wetlands and for their demonstrated success.

Therefore, there is an opportunity to trial smaller stepping-stone wetlands that provide suitable habitat and don't dry out, but which can fit into irregular spaces, smaller corridors or on land that can't be excavated. The Sydney Olympic Park Authority (SOPA) is using a range of smaller wetlands for the Green and Golden Bell Frog, a species closely related to the GGF. Inexpensive examples include sheep troughs and bunded areas with plastic liners or rubber (HDPE) lined wetlands (see Figure 8). These wetland styles could be replicated and trialled in the Merri Creek Strategy area. Priority links within the Strategy area could act as demonstration sites.

Additionally, there are some local examples of where smaller, permanent sites are effective. Some of the quarries in the former Epping Tip site act in this way; they have been observed to dry down to a tiny groundwater-fed sump that sustains GGF (G. Heard pers comm. 2022).

Figure 8. Examples of some of the wetland types successfully used at the Sydney Olympic Park for the Green and Golden Bell Frog L-R: Plastic Tarp lined breeding ponds; Rubber HDPE lined pond; Plastic trough (now installed by the City of Whittlesea in Epping).

Photo credits: Sydney Olympic Park Authority

Option for habitat link design

The development of this Strategy has provided an opportunity to investigate an option for a habitat link. This may provide a precedent for GGF habitat link planning in the future and to help inform a set of guidelines for linking habitat. This proposed habitat link from the Bolinda Road former Quarry to Merri Creek utilises most of the elements outlined in DEECA's *GGF Habitat Design Standards* (2017). Dr Geoff Heard assisted in its design. Figure 9 shows the general layout for the link which features 3 large new wetlands (0.35ha-0.45ha) each approximately 150m apart, linking to existing wetlands (solid blue shape) close to Merri Creek. The minimum width of the link is 50 m and the area between the large wetlands is interspersed with smaller wetlands, which could be of the sort used at Sydney Olympic Park, and suitable terrestrial habitat.

The exact location of this link has not been formalised, but the layout shown below demonstrates what is deemed to be a best option scenario on the basis of current conditions. The western most extent of the link is fixed as the development of the Bolinda Road Quarry has only one possible exit point for GGF, in the south-eastern corner.

Another factor in the implementation of this link is that wetland habitat would need to be established above ground level as the majority of the site is a landfill. This has been factored into a more detailed draft concept plan which has been presented to Hume City Council.

Figure 9. Concept Plan for potential habitat link from former Bolinda Road Quarry to Merri Creek

Discussions with Hume City Council will determine the final location and design of this link but the layout is provided as a worked example of a current best-practice habitat link.

In addition to new habitat links, the Strategy area contains some existing attempts to construct supplementary linking habitat for the GGF. These are along the southern section of the Melbourne Wholesale Markets site in Epping (see Map 5); along the Central Creek corridor to the south of Cooper Street (see Map 2); and along the southern boundary of the Biodiversity Park development on Cooper St towards the Merri Creek (shown in Map 2 and Figure 9). However, to date there is no evidence that these links are working. Important factors in ensuring the success of linking habitats such as width of habitat, no overshadowing, areas of deep water, long hydroperiod, inclusion of large wetlands, watering regime (wetting and drying) control mechanisms, control of aquatic plants, and other elements, are missing in these examples. Unfortunately, in lieu of habitat improvements and in the absence of any positive monitoring information it is unlikely that these links will be successful. In each case the linking habitat is generally less than 25 m in width and only includes shallow and small wetlands which quickly become overgrown with dense stands of emergent vegetation that makes them unsuitable for GGF breeding.

For these existing but non-functional habitat links, options for improvement (widening, trialling supplementary habitat, monitoring, and adjusting and actively managing vegetation/hydroperiod) should be pursued. There may not be options for improvement for areas that are excessively overshadowed (Figure 10).

Neither DEECA's GGF design standards nor Heard et al (2010) provide specific guidance for constructed habitat links, particularly for situations where width is restricted. In some areas it will not be possible to achieve the GGF design standards and for these cases, design guidelines for smaller habitat linkages would be useful. The potential Bolinda Road habitat link (Figure 9) provides an option for what suitable linking habitat may look like.

Another important element of linking habitat which appears to be failing are the series of fauna underpasses that have been incorporated into the road network. Specific examples within the Strategy area include a number beneath the Craigieburn Bypass (shown in Map 5), and others beneath Edgars Road. The effectiveness of these structures is unknown and monitoring data is scant. Anecdotal evidence suggests that they are ineffective and recent observation shows that the underpasses themselves as well as associated wetland habitat near the entrances to some are not receiving management or maintenance. As the failure of these underpasses means that the connectivity of GGF populations is reduced, it is important that this is investigated in the future and solutions sought from road management authorities.

Figure 10. Narrow, shadow affected reserve area intended as a GGF habitat link on the southern border of Biodiversity Park, Epping. Note extensive overshadowing of the area.

Objectives and Actions – Creating and Improving Habitat Links

Objective	Actions	Priority and timeframe
O12 Establish adequate links for breeding habitat locations: **Ensure that no breeding habitat location becomes isolated and improve links between existing habitat.**	A12.1.1 The Masterplan for Hume City Council's Bolinda Road property will include appropriate recognition of the requirements for GGF conservation and include options for GGF conservation provisions within the property.	High priority Current and ongoing
	A12.1.2 For the Bolinda Road Quarry breeding habitat location, MCMC and Hume City Council work to create linking habitat aiming to provide the best chance of maintaining connection to Merri Creek and other populations.	
	A12.2 For other proposed GGF linking habitat, ensure best practice design options, based on DEECA GGF Habitat Design Guidelines are used, with appropriate adaptation where there are site restrictions.	As required
	A12.3 Develop best practice guidelines for GGF linking habitat based on DEECA GGF Habitat Design Guidelines.	Medium priority
	A12.4 Ensure the implementation of a monitoring and maintenance program for any linking habitat that is created.	Medium priority, as relevant.
O13 Enhance the habitat values of existing areas of 'linking habitat' within the Strategy area.	A13.1 Seek opportunities to monitor for the presence of GGF in existing habitat links and use the findings of this monitoring to inform future efforts to enhance these links.	Prior to any habitat link enhancement work
	A13.2 Advocate to relevant authorities to seek improvements to existing areas of linking habitat as opportunities arise. This should include but not be limited to seeing improvements in the effectiveness of GGF underpasses.	Lower priority action Longer term

4.5 Enhancing Terrestrial Habitat

The terrestrial habitat that adjoins water bodies is where the GGF forage, bask, seek refuge, disperse and travel. Therefore, it is very important that this habitat is appropriate in its structure and composition. DEECA's *Growling Grass Frog Habitat Design Standards* (2017a) provide a set of terrestrial habitat standards which feature low-growing vegetation, open areas of soil and the inclusion of rocks. The information in these guidelines should be utilised as a minimum to guide terrestrial management in areas adjoining GGF waterways and water bodies within the Strategy area.

In New South Wales the use of other features such as rock piles, log piles and piles of lopped vegetation or mulch, called warm piles, have all been used with some success for the Green and Golden Bell Frog. These simple additions provide shelter and in the case of the lopped vegetation or mulch, have the capacity to generate heat. This latter feature may be particularly beneficial for the GGF in cooler seasons. The use of warm piles should be trialled for the GGF, and their success measured. If they prove useful, future iterations of the GGF Habitat Design Guidelines could include these measures.

Terrestrial habitat requirements need to be more widely known and understood by landscape designers and other professionals who work on development proposals aiming to create GGF habitat.

Figure 11. Vegetation adjoining the Merri Creek south of Barry Road

Objectives and Actions - Enhancing Terrestrial Habitat

Objective	Actions	Priority and timeframe
O14 Reduce woody weed cover and reduce biomass cover as appropriate in priority areas adjoining GGF habitat.	A14.1 Undertake woody weed management along priority stretches of the waterways such as on Merri Creek north and south of O'Herns Road. A14.2 Consider native woody shrub reduction where overshadowing may be affecting known GGF habitat. Focus on planted native shrubs that aren't aligned with appropriate EVC structure and abide with all relevant regulations and legislation.	High priority Aim for <1% cover of woody weeds within 5 years.
	A14.3 Liaise with land managers to seek to reduce biomass cover adjacent to GGF breeding habitat. Prioritise grassy weed management.	High priority Within 5 years
	A14.4 Ensure any planting lists for locations adjoining GGF waterways or wetland habitat areas contain appropriate species and plant cover densities. These should aim to have very low or no cover of any vegetation that could crowd out the banks or overshadow rocky or instream habitats.	Moderate priority Within 2 years and prior to any planting that adjoins waterways/ wetlands within the Strategy area
O15 Conserve or incorporate rocky environments adjoining wetlands or waterways.	A15.1 Seek opportunities to increase rocky cover in locations adjoining wetlands or waterways as relevant.	Low priority As the opportunity arises
O16 Increase awareness among landscape designers and similar on applying the *Growling Grass Frog Habitat Design Standards* (DELWP 2017a).	A16.1 Seek opportunities to run industry awareness events for professionals such as landscape architects on how to design GGF compensatory habitat, based on the *Growling Grass Frog Habitat Design Standards* (DELWP 2017a) including terrestrial habitat requirements.	Moderate priority Within 2 years

4.6 Stormwater Wetlands

Stormwater wetlands have become important yet precarious habitat for the GGF, particularly on the western side of the Merri Creek. Sites that appear to have sustained populations for a couple of decades include the Barry Road and Horne Street stormwater wetlands in Campbellfield, managed by Melbourne Water. The Frog Court stormwater wetlands in Somerton, managed by Hume City Council also supported the species. These were reconstructed in 2019 and subsequent monitoring by Council indicate that they no longer seem to support a GGF population. Each of these stormwater wetlands services an industrial sub-catchment. Development north and south of Cooper Street (both sides of the Merri Creek) is leading to an increase in the number of stormwater treatment wetlands in the Strategy area. A stormwater treatment wetland constructed in 2023 by Merri-bek City Council at Moomba Park, in Fawkner has supported GGF breeding in its first year and includes a purpose built GGF habitat pond. This pond meets some of the GGF habitat design standards (DELWP 2017a) and is fed by treated stormwater.

Whilst it is encouraging that some of these stormwater treatment wetlands support the presence of the GGF, this habitat poses serious risks to resident GGF. Stormwater treatment wetlands are designed to collect and treat contaminated stormwater with a particular focus on reducing suspended solids, nitrogen and phosphorus. They also receive and to some extent remove toxicants that occur in stormwater. This leads to the accumulation of contaminants within the stormwater treatment system and is likely to lead to the gradual diminution in the quality of the GGF habitat. Additionally, these wetlands need to be 'reset' every 5-10 years or so, requiring the removal of the wetland vegetation and accumulated sediments, potentially injuring or displacing resident frogs. Stormwater treatment wetlands normally include a sediment basin followed by a treatment pond; sometimes only the sediment basin will require resetting.

An added risk to GGF in stormwater treatment wetlands is that a chemical spill into the upstream stormwater drainage system, whether deliberate or accidental, could extinguish any resident GGF.

Melbourne Water, the current manager of two stormwater wetlands, manage these locations primarily for their stormwater treatment function and not for their habitat value. They have an exemption under the Environment Protection and Biodiversity Conservation Act 1999 for any inadvertent impacts to resident GGF through the maintenance and operation of these wetlands. Melbourne Water monitors their stormwater wetlands prior to any reset and works to a management plan throughout the process. This may involve the employment of appropriately qualified zoologists to translocate animals including frogs prior to maintenance and upkeep works.

The reset process needs to be fully considered and planned to ensure resident GGF populations are not compromised in this process. At present there are no clear or consistent guidelines to direct the success of this process, something that could be of benefit to all constructed wetland managers in a similar situation.

Objectives and Actions - Stormwater Wetlands

Objective	Actions	Priority and timeframe
O17 While recognising the primary function of stormwater wetlands, aim to minimise harm to resident GGF.	A17.1 Strategy Implementation Group seek to identify options for improved toxicant reduction within stormwater system, especially from industrial areas.	Moderate priority Within 5 years
	A17.2 Develop clear and consistent protocols for stormwater wetland managers to protect GGF populations during wetland resets or other management works. A17.3 Monitor the effectiveness of initial implementation of the protocols and update and improve where required.	High priority Within one year
	A17.4 Strategy Implementation Group seek and support projects to develop dedicated GGF habitat adjacent to stormwater wetlands that are known to support GGF breeding populations.	High priority Ongoing and as opportunities arise.

Figure 12. Barry Road stormwater treatment wetlands. GGF are persisting in these wetlands

5. Part C - Supporting priorities

The themes that are described in this section include objectives and actions that aim to improve the overall situation for the GGF within the Strategy area, but which are not specifically location focussed. They aim to address systemic, social and policy driven issues affecting the plight of the GGF.

5.1 Managing Stormwater and Water Quality

The Merri and Edgars Creeks within the Strategy area receive a variety of sources of water: treated and untreated stormwater as well as treated effluent from the Craigieburn Treatment Plant, managed by Yarra Valley Water.

At times of moderate to high rainfall the waterways experience high inputs of stormwater due to the high cover of impermeable surfaces within urban areas. This has altered the natural flow pattern. While new urban areas in the northern Merri catchment are subject to stormwater reduction targets, current impacts will continue due to the current and increasing extent of impermeable surfaces.

Additionally, stormwater if not adequately treated contains high levels of sediments and pollutants. These elements impact negatively on the GGF and the instream vegetative habitat on which it relies.

The waterways within the Strategy area are also susceptible to one-off serious pollution events. An example of this is the Patullos Lane fire in 2015 where fire-fighting water transported pollutants into the Merri Creek in Somerton threatening the local GGF population. Improved procedures are required to reduce the likelihood of these serious pollution events.

The issues around addressing stormwater contamination are exacerbated by the complicated nature of stormwater infrastructure and the fact that it is managed by different organisations. For example, stormwater catchment areas larger than 60 hectares are managed by Melbourne Water while smaller drainage systems are managed by councils. In addition, there are some private industrial sites with no formal stormwater connections.

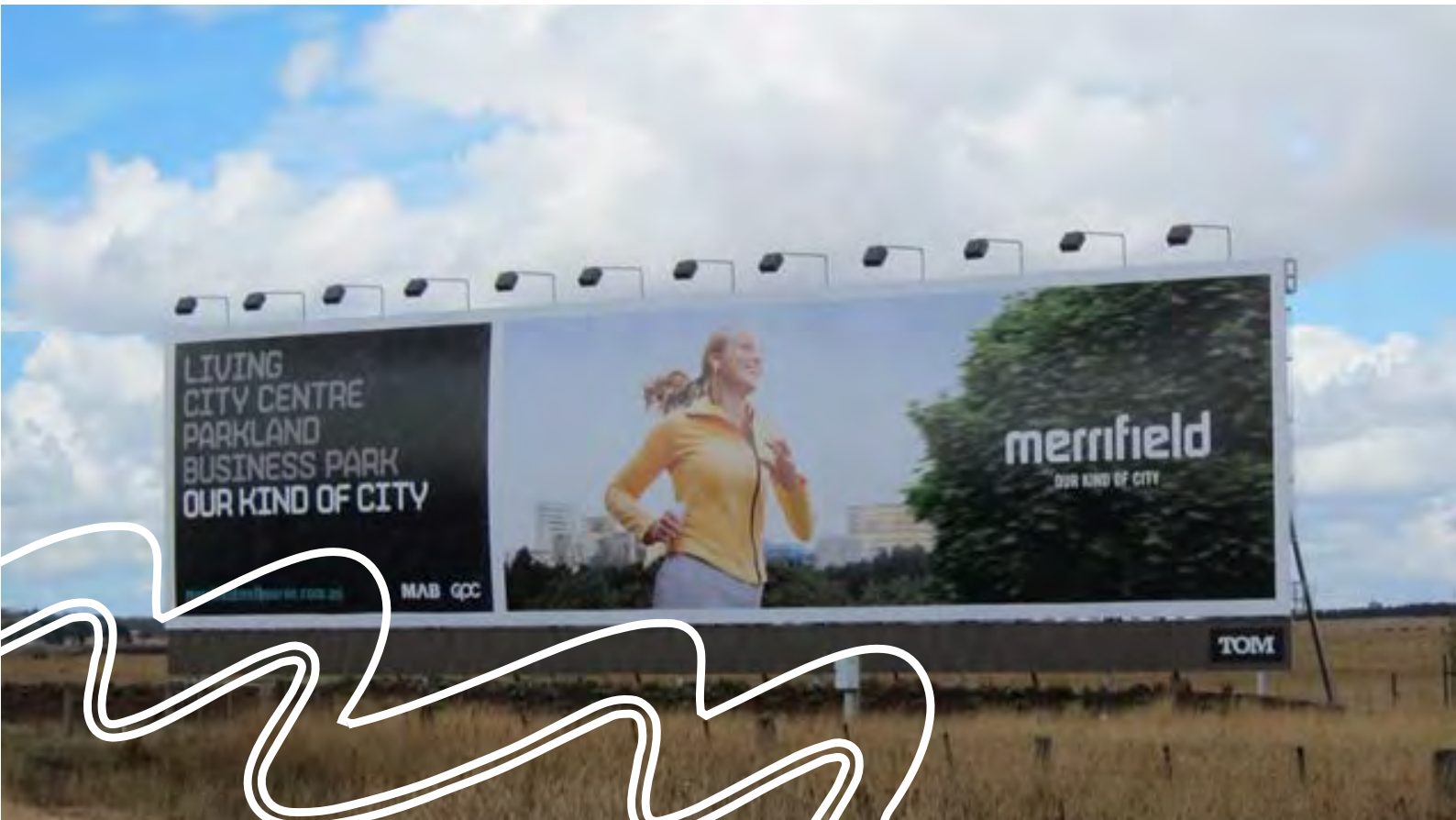
In older areas, there is frequently no treatment of stormwater, and opportunities to apply end of pipe solutions like stormwater treatment wetlands are often limited because of lack of space. All newer developments are required to meet best practice stormwater treatment standards.

The Strategy area does not fall within a Melbourne Water stormwater priority region. In most cases, Melbourne Water and councils current preferred strategy for seeking improvements to stormwater is to focus on education, enforcement and greater emphasis on stormwater capture (e.g., rainwater tanks) and reuse on site.

Objectives and Actions - Managing Stormwater and Water Quality

Objective	Actions	Priority and timeframe
O18 Aim to see higher levels of permeability and stormwater capture and use within existing and future urban and industrial areas within the local and upstream catchment.	A18.1 Engage with local and state authorities to seek: • a pilot project within a local industrial area. • improved regulation around introducing green infrastructure that will help to achieve this objective.	Medium priority Within 3 years
O19 Seek improvements that will see less impact via pollutants from industrial stormwater.	A19.1 Organisations responsible for stormwater management to identify the need for any extra stormwater treatment infrastructure within the catchment. Focus on industrial areas which do not have adequate infrastructure.	Medium priority Within 3 years
O20 Support improvements that will see less impact upon waterways associated with future emergency industrial situations such as leaks and fires.	A20.1 Seek to ensure that every industrial catchment in the Strategy area has adequate contingency provisions to mitigate impacts in emergency situations. Prioritise locations that could directly impact the instream O'Herns Road metapopulation.	High priority Aim to see improvements within 3 years
	A20.2 For new industrial developments - ensure that the design of all new stormwater treatment assets consider pollution incident capture.	Medium priority Aim to engage with relevant authorities within 2 years

Figure 13. Urban growth to the north of the Strategy area increases pressure on in-stream GGF habitat via increased stormwater volumes and poorer stormwater quality



5.2 Groundwater – Feeding the Ecosystem

Groundwater is vitally important to ensuring the quality of off-stream GGF habitat. This includes current habitat such as within quarry holes and potentially for future constructed off-stream habitat. It also provides baseflow to instream habitat in times of extended low rainfall. Scientific research strongly suggests that groundwater which is slightly saline and warmer than surface water assists the GGF to remain healthy and resist Chytrid Fungus infection. Deeper regional aquifers associated with Silurian and Tertiary aged sediments are most commonly intersected in quarry holes which provide breeding habitat to some GGF populations, whereas near-surface aquifers associated with the Newer Volcanic basalts may contribute to other groundwater-fed environments. It is acknowledged that there may be limited action that can be taken within the Strategy area to see beneficial local outcomes, but an increased awareness of the value and function of groundwater influenced ecosystems is deemed to be useful.

Groundwater models that have been developed for similar landscapes in the Merri and Darebin Creeks to the north of the Strategy area show that local groundwater recharge zones for the Newer Volcanics include stony rises and eruption points such as Mt Fraser and Hayes Hill (Figure 14). These local stony rises and eruption points as geological features or elements of ecological function do not currently have any level of planning or legal protection in their own right. The functional dynamics of the regional aquifer are not well known and similarly are not given much consideration for conservation despite its important role in ecosystem support services.

While groundwater models for locations to the north of the Strategy area provide some guidance, a local groundwater model that focuses on the Strategy area and which considers development scenarios would be informative.

Figure 14. Hayes Hill, Donnybrook

Objectives and Actions - Groundwater

Objective	Actions	Priority and timeframe
O21 Acquire a better understanding of the local groundwater system.	A21.1 Seek funding to engage a specialist to develop a groundwater model for the local region to better understand groundwater interaction and how it supports groundwater dependent ecosystems and species such as the GGF. Survey waterways within the Strategy area along their length to identify groundwater discharge points.	Low priority Within 5 years
O22 Identify locations that are important for ensuring local recharge is maintained and seek methods to protect them.	A22.1 Utilise planning mechanisms such as an appropriate schedule for the Environmental Significance Overlay to put in place conservation measures for local recharge zones.	Medium priority Within 5 years
O23 Aim to see higher levels of local soil and groundwater infiltration via increased green infrastructure within existing and future urban and industrial areas within local and upstream catchments.	A23.1 Engage with local and state authorities to seek a pilot project within a local industrial area. A23.2 Engage with local and state authorities to seek improved regulation around introducing green infrastructure that assists with stormwater infiltration in-situ.	Medium priority Begin engagement with authorities within 2 years

5.3 Predatory Fish and Crustacea

Three fish species, European Carp **Cyprinus carpio*, Redfin Perch **Perca fluviatilis* and Eastern Mosquitofish **Gambusia holbrooki* are known or thought to prey on the GGF.

European Carp are believed to be of particular concern to the instream population in the Merri, especially within the pools to the north of O'Herns Road Somerton. Eastern Mosquitofish are known to be present in the northern quarry hole at the Former Epping Tip site at 215 Cooper Street and threaten the success of any future use of that wetland as GGF habitat as part of the New Epping development. In addition to the abovementioned fish, the Common Yabby *Cherax* destructor is thought to be at least partially responsible for the demise of a population of approximately 100 GGF in a constructed wetland at the Aurora Estate, Epping (Koelher et. al. 2015).

Objectives and Actions - Predatory Fish and Crustacea

Objective	Actions	Priority and timeframe
O24 Better understand impacts of and manage predatory fish and crustacea.	A24.1 Commission a survey of the fish and crustacea present within the Strategy area, especially focussed on the priority instream habitat in the O'Herns Road area. A24.2 Based on the findings of this research, develop a plan to reduce the impact of these predatory species on the GGF in important locations.	Medium priority Within 3 years
	A24.3 Ensure that all new created GGF wetland habitats are above 1 in 100-year floodwater levels. If supplementary creek water is needed, ensure pumps are fitted with fish-removal devices.	For every project, as relevant.

Figure 15. European Carp

5.4 Engaging Communities and Neighbours

The Merri Creek Management Committee and Friends of Merri Creek run regular events within the Strategy area to engage the community with the waterways and their values. The Victorian National Parks Association ran a community monitoring project for the GGF across two seasons (2010-2012), which was supported by expert zoologists, at the City of Whittlesea Epping Quarry Hole. In recent years Melbourne Water and the Frog Census program has aimed to increase community participation in frog surveys. Additionally, in 2021 the 'Gone Growling' program, run for the first time in 2021-22 by DEECA, saw new GGF records from citizen scientists.

In addition to these types of community activity, there is scope for active engagement with specific groups that neighbour the waterways and habitats within the Strategy area, for example local businesses and residential communities in Thomastown, Campbellfield, Somerton, and Epping.

This theme aligns with existing local government and government authority objectives, meaning that some of these activities may be able to be supported by via existing funded programs such as Waterwatch and engagement programs.

Objectives and actions - Engaging Communities and Neighbours

Objective	Actions	Priority and timeframe
O25 Engage with local industry.	A25.1 Aim to hold one event per year that focuses on an industrial area adjacent to the Strategy area highlighting how adjoining industries can assist the creek and the GGF.	High – medium priority Annually
O26 Engage with local residential neighbourhoods.	A26.1 Aim to hold one event per year that focuses on a residential area adjacent to the Strategy area with a focus on ways that neighbouring communities can assist the creek and the GGF.	High – medium priority Annually
O27 Connect with existing initiatives that support citizen science monitoring and add value where useful.	A27.1 Strategy Implementation Group to collaborate to identify opportunities to support and promote initiatives such as the Gone Growling project and Melbourne Water's Frog Census app. If relevant, link events or find ways of adding value to current projects.	Medium priority Where appropriate, but ideally annually during the summer survey season.
O28 Engage with others undertaking conservation works for the GGF.	A28.1 Organise or support learning and information sharing opportunities amongst land managers, scientists and policy staff who share an interest in conservation of the species. This could include a field day, seminar, or online session.	Medium priority Ideally an event annually

Figure 16. Community event run by MCMC. Image: Merri Creek Management Committee

5.5 On-Ground Monitoring and Maintenance Team

An intensive species management approach has been successful at the Sydney Olympic Park for the Green and Golden Bell Frog. This approach has involved significant amounts of habitat creation and enhancement, experimentation, monitoring and adaption. An on-ground team undertake monitoring and maintenance of this habitat and the GGF populations therein. A similar approach of establishing a specialist GGF monitoring and maintenance team could be trialled in the Strategy area and long-term funding sought to support these endeavours. There may be various options for how such an on-ground team could work to enhance the efforts of existing monitoring and maintenance programs.

Objectives and Actions - On-Ground Monitoring and Maintenance Team

Objective	Actions	Priority and timeframe
O29 Scope options for the establishment of a specialist on-ground management team for the GGF within the Strategy area.	A29.1 Develop a program of work for an on-ground monitoring and maintenance team focussed on improving the sustainability of the GGF within the Strategy area. Focus on the monitoring and maintenance of GGF habitat such as constructed wetlands, stormwater ponds, quarry holes, instream habitats and more. The program of work will be informed by GGF experts and may be used to assist in addressing gaps in knowledge. It will involve an iterative and hands on approach. Seek funding for a multiple year program for at least two staff (possibly to work outside of the Strategy area as well as within it).	Medium priority Program of work developed within 3 years Seek funding once the program of works is developed with the aim of getting started as soon as possible

Figure 17. Pond adjacent to Merri Creek below the Bolinda Road Landfill area, Campbellfield

5.6 Addressing Knowledge Gaps

In undertaking background research to inform this strategy document a number of knowledge gaps were identified and it's likely that in the course of the strategy implementation, more will be found.

It will be important to build on existing relationships with species experts, research institutions and other organisations that manage similar species, such as the Sydney Olympic Park Authority and the University of Newcastle, in order to develop formal and informal programs of research to address gaps in knowledge.

Objectives and Actions - Addressing Knowledge Gaps

Objective	Actions	Priority and timeframe
O30 Engage with academics, researchers and other managers of similar species and develop research programs to address knowledge gaps.	A30.1 Explore options for a program of research with academics and experts to address knowledge gaps. Some initial ideas based on background research include: • Confirm the success or otherwise of GGF underpasses with road authorities and seek options for improvement • Trials of new habitats such as some of those used at the Sydney Olympic Park including small, inexpensive pond types; also warm piles • Trial the use of sound recorders to complement on-ground monitoring effort – especially at key locations such as Frog Court • Experiment with water chemistry at select locations (where appropriate) to reduce the impacts of Chytrid fungus • Further investigate the newly confirmed population in Fawkner and whether there are linkages with populations north of the Ring Road • Trial approaches to reduce the impact of predatory fish or crustacea on populations of GGF	Medium priority Aim for one research project every two years

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