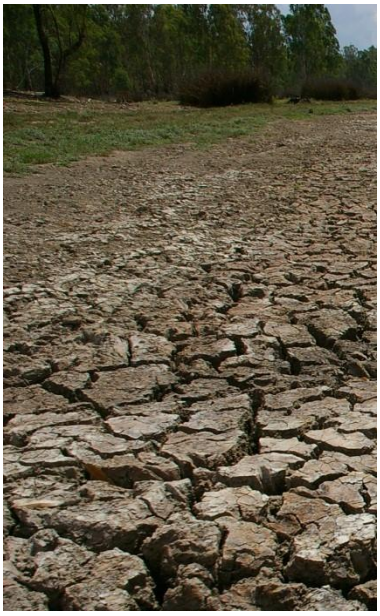
Emergency Preparedness and Response Plan for Biodiversity and Agricultural Natural Capital Assets in the Goulburn Broken Region


June 2024

GOULBURN BROKEN
CATCHMENT MANAGEMENT AUTHORITY

ACKNOWLEDGEMENT OF COUNTRY AND TRADITIONAL OWNERS

The Goulburn Broken CMA acknowledges and respects First Nations people and the deep connection they have with their land and waters. We acknowledge the Yorta Yorta and Taungurung people and their ancestors/forbears as Traditional Owners of the land and waters in the Goulburn Broken catchment (and beyond). We value our ongoing partnerships with YYNAC and TLaWC for the health of Country and its people.

We pay our respects to Elders past, present and emerging and acknowledge and recognise the primacy of Traditional Owners' obligations, rights, and responsibilities to use and care for their traditional lands and waters.

Publication details

Emergency Preparedness and Response Plan for Biodiversity and Agricultural Natural Capital Assets in the Goulburn Broken Region (GB CMA 2024)

This Plan seeks to improve preparedness for, response to, and recovery from emergency events as they relate to Australian Government biodiversity and agricultural natural-capital assets. This will be achieved through improved integration of assets in emergency planning, response, and recovery.

The Plan will enhance the resilience of biodiversity and agricultural natural-capital assets by recognising the risks and threats posed by natural disasters and undertaking planning to improve outcomes through actions and management before, during (to the extent possible) and post-event to support recovery.

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Contents

1. BACKGROUND

Biodiversity and natural capital in our region

Biodiversity is a term used to describe all life forms including different plants, animals, micro and macroorganisms, their genetic diversity and the ecosystems where they connect. The Goulburn Broken catchment is unique, boasting a wide diversity of biodiverse landscapes including 1,800 metre snow covered alps, moist montane and dry sclerophyll forests, granitic outcrops, gentle sloping plains, box woodlands, red gum floodplains, seasonal herbaceous wetlands, plains wetlands and grasslands, mixed farms, irrigated pastures, and orchards.

Traditional Owners have intrinsically managed the land for the survival of all living things for tens of thousands of years and their deep connection to the region's cultural landscapes continues today. The Goulburn Broken catchment includes two Registered Aboriginal Parties who represent the interests of Traditional Owners in their respective Country areas: Yorta Yorta Nation Aboriginal Corporation (YYNAC) and Taungurung Land and Waters Council (TLaWC), as well as other Aboriginal organisations. First Nations People's participation in Caring for Country and natural resource management in the catchment is prioritised and supported through strong partnerships, collaboration, co-design, delivery, and sharing of knowledge, skills, and experience. High level actions relating to use of a cultural lense for emergency preparedness, response and recovery are noted in this Plan, however we knowledge that there are extensive learning and improvements to be made.

Across the landscapes of the Goulburn Broken catchment, there are approximately 2,750 native plant species of which 13% are threatened, and 493 vertebrates of which 22% are threatened. Relatively little is known about the invertebrate fauna, but threatened species include species such as the Golden Sun Moth. Some species that once occupied the catchment are now extinct, such as the Eastern Bettong. Many threatened species persist only in small patches of remnant habitat, for example the Mountain Pygmy-possum in the alpine boulder fields.

Native vegetation, along with other elements, provide key habitat for much of the wildlife above and below the ground and is critical to the resilience of the catchment's biodiversity. Many different native ecological communities are found across the catchment, depending on factors such as topography, soil types and rainfall. Vegetation can be found as remnants on private land, public land such as national parks, reserves, and roadsides, and along waterways. Most of the catchment's native ecological communities are found on public land which covers approximately one-third (800,000 ha) of the catchment. This includes several sites of high biodiversity value such as the internationally important Barmah Forest Ramsar site, the Lower Goulburn National Park, Heathcote-Graytown National Park, Reef Hills State Park, and Alpine National Park.

Seventy percent of the catchment is privately owned (1.68 million ha), with about 63% managed primarily for agricultural production and the remaining 7% a mix of rural residential and urban development. Traditional agricultural businesses such as cropping, livestock, horticulture and dairy production remain dominant, although the area of irrigated land is decreasing (GB CMA 2024).

'Natural capital' describes the stock of renewable and non-renewable resources that provide ecosystem services, which in turn deliver a range of benefit to people. All businesses, including agricultural businesses, depend either directly or indirectly on natural capital. In the context of agriculture, natural capital assets may include soil, air, water, remnant native vegetation, environmental or agroforestry plantings, native fauna (e.g. birds, bats, invertebrates), and riparian areas. These assets provide a range of ecosystem services that support agricultural production including nutrient cycling, soil stability, amenity, water filtration, shade and shelter for livestock, pollination, and pest management.

Clearing for agriculture and urban development was widespread and relatively fast paced from the 1880s to the 1950s, removing large areas of native vegetation and transforming the landscape. This resulted in reduced habitat, changes to ecosystem processes and the extinction of several species of flora and fauna with many others under threat of extinction. Many land managers are improving their practices and carrying out activities such as revegetation and soil conservation which have positive effects on extent and condition of natural capital. However, the overall quality of some assets such as native vegetation is declining, and the landscape context/patterns are changing due to past practices, altered fire regimes, pest plant and animal impacts and the compounding effects of climate change.

Natural disasters and emergency events

Due to key drivers such as climate change, there is a growing need to enhance our preparedness for natural disasters and their impact on biodiversity and agricultural natural capital assets. Ensuring the survival of species and places helps to preserve key ecosystems services such as clean air, water, and climate regulation, all of which profoundly affect human well-being. Disaster preparedness bolsters the resilience of ecosystems, enabling them to recover and flourish following catastrophic events. Better preparation and response also contribute to stronger regional economies through sectors such as tourism and agriculture. For example, by investing in disaster preparedness, long-term costs for recovery and restoration post-disaster may be reduced.

Victoria is one of the most bushfire-prone areas in the world. Victorians are accustomed to living with bushfire risk, which is the likelihood and consequence of bushfires. Victoria's changing climate brings with it rising average temperatures, more hot days, and less rainfall, resulting in an increasing risk of bushfire as fuels dry out and extreme fire weather events increase. The disastrous 2019–20 bushfire season was fuelled by very hot, dry, and windy periods), following periods where parts of Eastern Australia had experienced their driest conditions on record. Over 1.5 million hectares (ha) in Victoria were burnt and large areas of eastern Australia impacted (DELWP 2020).

The Plan contributes, in part, to actions under Target 17 of the *Threatened Species Action Plan 2022-32* and Outcomes 1, 2 and 3 of the Natural Heritage Trust (NHT), by addressing vulnerability from extreme weather events relevant to biodiversity and agricultural natural capital assets identified in the management unit and improving emergency response and planning within jurisdictions. The Plan also contributes to Outcomes 1 and 3 of the Climate-Smart Agriculture Program by supporting the agriculture sector to build resilience to climate change and conserve natural capital and biodiversity on-farm. It does so by considering the most likely disaster scenarios for the Goulburn Broken Management Unit, which include flooding, drought, and bushfire/heatwaves (noting that heatwaves can occur without bushfire).

The Plan was built on the lessons learned over many decades, with most recent natural emergencies including the Millennium Drought of 1997-2009, 2003 Alpine Fires, 2014 Bushfires, 2019-20 Black Saturday bushfires, and Northern Victorian flooding of October 2022 and January 2024. The Plan was also developed utilising existing Goulburn Broken Catchment Management Authority (GB CMA) regional planning policies and strategies, relevant emergency response agencies/government local, regional, state, and national strategies, and emergency management planning.

The GB CMA has been collaborating with partners and delivering natural resource management for over 25 years. The GB CMA is committed to providing support where the Authority can reasonably offer appropriate skills and resources in emergency events. Particularly, CMAs have extensive experience in floodplain management, and supporting communities and environmental assets due to flooding, fire, and drought, including the following examples.

Flooding

The GB CMA is a statutory authority which has been delegated flood plain management functions under the Water Act. The GB CMA played a pivotal role in the October 2022 and January 2024 floods. This included technical advice on flood mitigation to the Incident Control Centre (ICC), providing support to flood response, and leading flood recovery programs where there are resources to conduct works. GB CMA has a flood response action plan that sets out how to assist VICSES in an emergency and what flood data is to be captured, such as peak flood heights, discharge measurements and aerial flood photography. For example, in October 2022, the GB CMA used flood warning information and current knowledge of what was happening in the landscape and linked this to flood studies and modelling to predict floodwater behaviour. This work supported the decisions of various agencies in the ICC and provided the incident controller, the planning, intelligence, mapping, and media teams, with flood intelligence. During the flood event, GB CMA worked to make flood data meaningful and available through the flood portal for the community to use. The portal provides flood information such as flood coverages, floor depths and floor levels to identify land and property exposure at various gauge heights.

Bushfire

The GB CMA supported communities when a large band of lightning caused three significant bushfires in Creighton's Creek (5,000 hectares), Stewarton (3,000 hectares) and Boweya (5,750 hectares) on December 15th, 2014. The GB CMA worked closely with the Victorian Government (now DEECA), the Country Fire Authority, Goulburn-Murray Water, the Victorian Environmental Water Holder, the Department of Economic Development, Local Governments, Landcare Groups, and the community. Concerns about the impact of falling dissolved oxygen levels in waterways due to rainfall washing ash, nutrients, organic matter, and sediment into them, led the GB CMA and partners to arrange for environmental water to be sent down the upper Broken Creek. The GB CMA, in partnership with Goulburn Murray Water and the Victorian Environmental Water Holder, delivered environmental water to the upper Broken Creek downstream of the Stewarton fires to ensure this dissolved oxygen levels were maintained or improved. Stumps and logs from trees that had fallen or had been removed for safety reasons were also used in re-snagging programs in the Hughes Creek near Avenel and the Broken Creek near Numurkah, providing habitat for native fish.

Drought

Drought is an ongoing risk for farmers, biodiversity, and agricultural assets in the catchment. It inflicts major financial, social, and environmental costs on farm businesses and communities (Ag Vic 2023). Recovery from the Millennium Drought was difficult, exacerbated by the ever-changing agricultural environment and the impact on wetlands and waterways. The 1997-2009 drought followed by the 2017-2020 drought significantly impacted the resilience of irrigation farmers, and their capacity to respond and adapt to the ever-changing conditions. To address social and agricultural issues, the GB CMA harnessed its long-term relationships with regional partners to implement a Drought

Employment Program (DEP) which targeted farmers, farm workers, and local agribusiness workers impacted by the drought, who in turn delivered environmental works to protect significant biodiversity assets. The GB CMA and partners also delivered environmental water to drought affected wetlands to protect threatened ecosystems and water dependent species.

Where to from here?

On 19 September 2023 the Bureau of Meteorology declared an El Niño weather event and is forecasting an increased risk of drier and hotter conditions. Consequently, Australia can expect an increased risk of extreme temperature shifts, like heatwaves and hotter days, increased risk of storm events leading to flooding, and increased fire danger.

Given the looming threat of severe weather, along with the critical role of Regional Delivery Partners (RDPs) in supporting NRM preparedness and response, the GB CMA was invited by the Australian Government, along with all Natural Resource Management Regions across Australia, to deliver a 'Biodiversity and Agricultural Natural Capital Emergency Preparedness & Response Plan' (the Plan). The Plans will follow the same format and therefore enable an overview of opportunities to improve preparedness for, and response to, emergency events where they occur through better integration of biodiversity and agricultural natural capital assets in emergency planning and response.

2. OBJECTIVES OF THIS PLAN

The objectives of the Plan are to improve preparedness for, and response to, emergency events where they occur through better integration of biodiversity and agricultural natural capital assets in emergency planning and response. This includes efforts to enhance the resilience of biodiversity and agricultural assets by recognising the risks and threats posed by natural disasters and undertaking planning to improve outcomes through actions and management before, during (to the extent possible) and after to support recovery.

3. SCOPE

The scope of the Plan is the identification of preparedness actions and not their implementation. This includes for the following emergencies:

- Flooding
- Fire
- Drought /Heatwaves

Where preparedness actions have already been identified in existing strategies (e.g. Goulburn Broken Catchment Regional Floodplain Strategy 2018-2028, Goulburn Drought Resilience Plan, Hume Bushfire Management Strategy 2020, and National Recovery Plans), these have been collated (and not re-developed) to ensure alignment with existing strategies.

Due to the significant number of landscapes, and consequently ecosystem types and the threatened species they contain, only species/communities listed as threatened under the *Environment Protection and Biodiversity Conservation* (EPBC) *Act* 1999 have been included. Further work would be required to also include priority species listed under the Victorian *Flora and Fauna Guarantee* (FFG) *Act* 1988.

First Nations cultural landscape approach

Traditional Owners in Victoria seek to lead management of Country through a cultural landscape approach, which has led to development of the Victorian Traditional Owner Cultural Landscape Strategy (the Strategy). The Strategy redefines caring for Country by the world's oldest living culture.

"The purpose of the strategy is to embed, at statewide level, Traditional Owner Management of Country… to effect transformational change in contemporary land and water management."

The Strategy sets out a framework to systematically enable and empower Victorian Traditional Owners to activate cultural knowledge and practices to manage Country. It provides a pathway that enables land, water, fire and biodiversity managers across government departments and agencies to embrace systemic changes in policy, planning, governance, and management practices.

Consideration of alternative, culturally appropriate categorisation approaches for this Plan would require a reframing that this timeline and scope does not allow for. However, where relevant, this Plan refers to existing strategies and assessments (e.g. (Hansby, et al. 2023)) that demonstrate a cultural landscape approach and are of relevance to preparedness or response actions for priority assets.

4. ROLE OF RDP IN EMERGENCY PREPAREDNESS AND RESPONSE

Australian state and territory governments have responsibility for coordinating and planning for the response to and recovery from a disaster within their borders. Under the *Victorian Emergency Management Act 2013*, emergency means "an emergency due to the actual or imminent occurrence of an event which in any way endangers or threatens to endanger the safety or health of any person in Victoria or which destroys or damages, or threatens to destroy or damage, any property in Victoria or endangers or threatens to endanger the environment or an element of the environment in Victoria including, without limiting the generality of the foregoing- (a) an earthquake, flood, wind-storm or other natural event; and (b) a fire; and (c) an explosion; and (d) a road accident or any other accident; and (e) a plague or an epidemic or contamination; and (f) a warlike act or act of terrorism, whether directed at Victoria or a part of Victoria or at any other State or Territory of the Commonwealth; and (g) a hi-jack, siege or riot; and (h) a disruption to an essential service."

The three tiers of emergency management

State

State level is managed through the Emergency Management Commissioner and State Control Team and generally based at the State Control Centre (SCC).

Regional

Regional level is managed through the Regional Controller (RC) and Regional Control Team (RCT). For the Goulburn Broken CMA these roles are based in the Hume Regional Control Centre at the DEECA office in Benalla. Goulburn Broken CMA will generally link to regional control through being a member of the Hume Regional Emergency Management Team (Hume REMT).

Incident

All incidents in Victoria establish incident management arrangements as per the Australian Inter-Service Incident Management System (AIIMS), depending on the level of incident. All incidents will be managed by an Incident Controller (IC) who leads an Incident Management Team (IMT). Leadership of the IMT is undertaken through an Incident Control Team (ICT) which generally includes the managers of all functional units. Support agencies will generally be linked to an incident through an Incident Emergency Management Team (IEMT).

As per the Ministerial Statement of Obligations, CMAs must provide support to control agencies in a flood emergency when requested and provide technical advice on flood behaviour and impacts, including the impact of levees or floodplain features during significant floods. CMAs shall develop and implement funded waterway-related restoration works programs following natural disasters such as bushfires or floods; and shall participate in regional contingency planning for blue-green algal blooms, fish deaths and black water events, and respond according to the roles assigned to it in these plans.

CMA's organisational readiness and response to forecast weather conditions will be aligned with state-wide arrangements outlined in Emergency Management Victoria's Joint Standard Operating Procedure (JSOP) Incident Management Team (IMT) Readiness Arrangements (JSP 2.03) which:

"outlines the process to establish the minimum predetermined level of readiness for Incident Management Teams (IMTs) based on the forecast severe weather conditions and consideration of potential risk."

While the JSOP does not directly apply to the CMA, it does apply to VICSES and other Control Agencies and hence defines the readiness arrangements for ICCs which the CMA may be required to support.

The activation and staffing of ICCs, RCCs and other response arrangement is based on readiness levels defined by thresholds / criteria dependent on the hazard type (i.e. fire / flood / storm).

The high-level overview of arrangements and specific details of agency roles and responsibilities in emergency management are available in the web-based SEMP document: Roles and Responsibilities | Emergency Management Victoria (emv.vic.gov.au).

The *Victorian Emergency Management* (EM) *Act 2013* establishes Victoria's emergency management framework which is outlined in Section 11.

Role of Catchment Management Authorities

Victorian Catchment Management Authorities (CMAs) are responsible for the integrated planning and coordination of land, water and biodiversity management in all catchment and land protection regions. CMAs have a key role to advise on flood mitigation, provide support to flood response, and lead flood recovery programs where they have the resources to conduct works. Emergency Management Victoria outlines the following Role Statement for CMAs in emergency management (preparedness, response, and recovery). Role statement - Catchment Management Authorities | Emergency Management Victoria (emv.vic.gov.au)

CMAs Role Statement in Mitigation / Preparedness

Activity
Advise and assist local government in the incorporation of flood related planning controls in planning schemes
Prepare flood response action plans for internal use focused on the collection of flood related data, flood level, flood photography, and hydrographics
In partnership with local government, prepare and implement local floodplain management plans in accordance with the regional floodplain management strategy and community expectations
Assist with specific strategic and regional (non-urban) works and measures in accordance with responsibilities under the regional floodplain management strategy or catchment management strategy in consultation with expert advice
Prioritise regional flooding issues in cooperation with local government, VICSES and the community
Participating agency for the following flood mitigation activities: • Legislative policy framework including floodplain management strategy, reform (lessons learnt) • Land use planning (Strategic and statutory) • vegetation/waterway management • Flood emergency planning including readiness

CMAs Role Statement in Response (including Relief)

Activity
Advise government on regional priorities for floodplain management activities through the implementation of regional floodplain management strategies
In partnership with support and control agencies, collect, maintain**,** and enhance flood information
Monitor significant flood events and collect flood data in conjunction with local government
Provide flood advice to local government and the community in general
Advise local government and other authorities on planning permit referrals, building issues and infrastructure management within floodplains
Assist local government, the BoM and DEECA support the development, maintenance and upgrading of regional flood warning systems
Support response agencies at the regional level through the provision of flood advice, including flood extent and severity during major flood events
Support response agencies through the provision of advice on emergency stabilisation and other activities to arrest river breakaways, and the removal of debris accumulation threatening structural stability of public assets in consultation with expert advice
Support community education and involvement on flooding issues
Assess all river waterway damage that poses a threat to the stability of river systems

CMAs Role Statement in Recovery

Activity
Recovery Lead Agency (RecLA) responsible to provide advice and information services to Councils and delegate public land managers and community groups (with DEECA and supported by DTP and EPA)
Recovery Support Agency (RecSA) to: • relevant land managers to undertake erosion control on public land to help manage risk to public safety, natural and cultural assets**,** and values, and infrastructure • DEECA in its role to survey and protect threatened bird, marsupial, aquatic and plant species and develop and implement protection activities to support ecosystem recovery and regeneration
• support DEECA, EPA and PV in fish death clean-ups where the fish death event is due to natural causes, and where the CMA has the resources. The CMA will lead a local fish death clean-up and larger scale clean-ups depending on resource availability
• restore, clear and rehabilitate waterways managed by CMAs, and support DEECA and PV in their lead role of rehabilitating, restoring and reinstating public land and tourism and visitor assets. DEECA or PV are directly responsible for managing to mitigate risks
Lead agency responsible to develop and prioritise bushfire and flood recovery programs for CMA assets/waterways
Support DEECA to deliver its recovery activities to: • restore impacts of river erosion where there is an immediate danger of the formation of river breakaways and/or immediate danger to CMA assets
• implement balanced bushfire and flood recovery programs consistent with funding allocated
Implement bushfire and flood damage restoration programs for bushfire and flood affected waterways

CMAs Role Statement in Assurance and Learning

Activity
Monitor and report on performance of regional floodplain management strategies

Source: Emergency Management Victoria

Goulburn Broken CMA's experience, knowledge, and expertise

The GB CMA has been collaborating with partners and delivering natural resource management in the catchment for over 25 years. The GB CMA fulfils its statutory role to provide support and expertise related to mitigation, planning, preparedness, response, and recovery from emergencies. It has ongoing, strong partnerships with emergency-service organisations such as Victoria State Emergency Services, Country Fire Authority, Department of Energy, Environment and Climate Action, and local government authorities. GB CMA have a proven track record of preparing, adapting, and responding to emergencies, with highly trained technical staff in a range of flood, biodiversity, and agricultural areas of expertise. GB CMA have built over many decades, strong partnerships with Traditional Owners and see much value in ensuring that Traditional Owner knowledge is applied to emergency preparedness.

The GB CMA is committed to providing support where the Authority can reasonably offer appropriate skills and resources. Although CMAs are not identified as a control agency for response of any emergency type, they can be called upon as a support agency at the direction of the Control Agency or Incident Controller. The protection of life and community is paramount during emergency response. There may be times when these priorities take precedence over others identified in this Plan.

5. BIODIVERSITY ASSETS - IDENTIFICATION AND SUSCEPTIBILITY

This section identifies the Goulburn Broken catchment's biodiversity assets. These include but are not limited to Matters of National Environmental Significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) such as key listed threated species and ecological communities, national heritage places, and Ramsar wetlands. There are no world heritage properties within the Goulburn Broken catchment.

Information provided for each biodiversity asset includes:

- A description and map of key locations in the Goulburn Broken catchment.
- Identification of emergency events that pose a threat, and why.
- An assessment of each asset's current susceptibility to emergencies, assessed as high, moderate, or low.

Priority biodiversity assets have previously been identified in regional strategic planning documents including the Goulburn Broken Regional Catchment Strategy 2021-2027. Biodiversity assets included in this Plan are informed by these documents, as well as by feedback and input from relevant stakeholders.

Biodiversity assets and locations were further prioritised for inclusion in this Plan based on the following criteria:

- Cultural significance or value to First Nations people.
- Long-term former investment by the Australian Government e.g. past Regional Land Partnership project sites.
- Located/situated where likelihood, frequency and/or severity of emergency events is significantly high.
- Located/situated where GB CMA have capacity to take impactful action before, during, or after an emergency event.

Assets are presented either individually or in groups depending on their conservation status, prioritisation under the Threatened Species Action Plan 2022-2032, or their unique vulnerability to specific emergency events.

Appendix 1, Figures 1-26 show estimated distributions and priority locations for biodiversity assets within the Goulburn Broken catchment.

Appendix 2 provides a multi-jurisdictional inventory of assets, outlining extent of distribution, jurisdictions, and relevant legislation and policies for each asset.

Threatened Ecological Communities

Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains

Environment Protection and Biodiversity Conservation Act (1999) status – **Critically Endangered**

Description

The 'Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains' ecological community (henceforth referred to as Seasonal Herbaceous Wetlands) are temporary freshwater wetlands that are inundated seasonally, typically filling after winter-spring rain, and then drying out. The vegetation is generally treeless and dominated by an herbaceous ground layer, often with a considerable graminoid component and with forbs present (DSEWPC 2012). During extended dry periods plants and animals that comprise these wetlands may not be visible but persist as desiccated material or propagules in the ground.

Location in the Goulburn Broken catchment

The Seasonal Herbaceous Wetlands ecological community occurs in Victoria, south-eastern South Australia, and southern New South Wales. It specifically occurs within Interim Biogeographic Regionalisation of Australia (IBRA) bioregions associated with lowland plains, notably the Victorian Volcanic Plain, South East Coastal Plain, Naracoorte Coastal Plain and Riverina bioregions, and the Wimmera subregion of the Murray Darling Depression bioregion (DSEWPC 2012).

Seasonal Herbaceous Wetlands occur on fertile soils on poorly defined seasonal drainage lines and depressions, or terrain characterised by gilgais[1]. The community occurs primarily on private land in the Goulburn Broken catchment, with the generally flat landscape and fertile soils being highly conducive to agricultural production including cropping and grazing. Clearing and other threats have removed or heavily degraded the natural vegetation surrounding the Seasonal Herbaceous Wetlands so that wetlands may now occur among highly modified cropland or improved pastures. Many wetlands were also removed when the surrounding dryland grassy communities were cleared.

Howell and McLennan (2002) analysed the Victorian Wetlands Database for wetland decline in the Goulburn Broken catchment to 1996. They noted almost 27 000 hectares (or 35% of the 1750 extent) of all major wetland types had been lost up to 1996. Most of that catchment's wetlands were temporary wetlands classified as freshwater meadows or shallow freshwater marshes and generally of small size, under five hectares.

Given their seasonal nature and concentration on private land there is limited knowledge of the current distribution of Seasonal Herbaceous Wetlands, but modelling undertaken by the Victorian Government (Papas, et al. 2016) provides an estimated distribution. A map is included in Appendix 1, Figure 1.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Seasonal herbaceous wetlands of the temperate lowland plains.	Drought /Heatwaves	Increased drought through climate change is a threat to the Seasonal Herbaceous Wetlands ecological community. Heatwaves, declining rainfall and shifts away from regular rainfall patterns can impact ecosystem composition. Repeat droughts will reduce the species richness and resilience of wetlands, largely through impacts on the seed and egg banks.	High	There are indications that changes in seasonal rainfall patterns are having an impact on the Seasonal Herbaceous Wetlands ecological community through more frequent drought and heatwaves.

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

Environment Protection and Biodiversity Conservation Act (1999) status – **Critically Endangered**

Description

The 'White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland' ecological community (henceforth called Box-Gum Grassy Woodlands) is characterised by a species-rich understorey of native tussock grasses, herbs and scattered shrubs, and the dominance, or prior dominance, of White Box, Yellow Box or

[1] Gilgai refers to surface micro-relief formed by the shrinking and swelling of clays during alternate drying and wetting cycles. The surface eventually becomes covered by a repeated pattern of small mounds and depressions that give the soil surface a 'pock-marked' appearance.

Blakely's Red Gum trees. The ecological community can occur either as woodland or derived native grassland, meaning a grassy woodland where the tree overstorey has been removed (DECCW 2010).

Location in the Goulburn Broken catchment

Box–Gum Grassy Woodlands were previously widespread along the western slopes and tablelands of the Great Dividing Range, from southern Queensland through NSW and the Australian Capital Territory to Victoria. In north east Victoria the community occurs on granitic or metamorphic geologies on moderately fertile clay loam soils where average annual rainfall is between 500 and 800mm per annum (DSE 2006).

As this community tends to occur on fertile soils, it has been preferentially cleared and is highly modified through grazing where it remains. Data on depletion of Victorian Ecological Vegetation Classes (EVCs) containing this community suggest that the extant Box-Gum Grassy Woodland community in Victoria is likely to be less than 6% of its pre-1750 distribution (DECCW 2010).

Within the Goulburn Broken catchment, remnants of this community occur predominantly on privately owned land as isolated patches within an agricultural landscape. The catchment nonetheless contains quality remnant sites, which display considerable diversity in size and structure. These sites occur around the following localities: Benalla, Warrenbayne, Baddaginnie, Glenrowan, Thoona, Dookie, Euroa, Violet Town, Mansfield, Bonnie Doon, Alexandra, and Gobur (DSE 2006).

A map is included in Appendix 1, Figure 2.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Bushfire	High intensity bushfires may kill mature, hollow-bearing trees and dependent fauna. Many ground-layer plants in the ecological community require spaces between the grassy tussocks to germinate and grow successfully. These gaps may be created by various disturbance sources including fire. Many plants recover quickly by re-sprouting. Cool burns can facilitate recruitment of some of the constituent plant species and increase ground layer diversity (DCCEEW 2023).	Low	The impact of repeated high intensity fires can impact this ecological community, for example through loss of mature, hollow-bearing trees. Too frequent fire can threaten recruitment in slow to moderate growing eucalypts such as Yellow Box, Grey Box and White Box which may not reach reproductive maturity before the next fire. However, species can recover vegetatively so this may not pose a substantial threat.
	Flood	Riverine flooding can impact these ecosystems through the spread of weeds.	Medium	Mapping indicates some remnants of this community occurs in higher parts of floodplain areas in the catchment.
	Drought /Heatwaves	Lack of long-term rainfall, is likely to contribute to reductions in extent, changed species composition, loss of species diversity due to fragmentation and isolation of remnants, and changes in understorey structure.	Low/medium	Impacts are based on climate change predictions.

Natural Grasslands of the Murray Valley Plains

Environment Protection and Biodiversity Conservation Act (1999) status – **Critically Endangered**

Description

The 'Natural Grasslands of the Murray Valley Plains' ecological community (henceforth called Natural Grasslands) is a type of natural temperate grassland with semi-arid characteristics, due to its restricted-rain environment. The

structure is an open grassland to forb land in which trees and tall shrubs are sparse to absent. The vegetation is dominated by a ground layer characterised by a range of perennial grasses, forbs, and small shrubs (DSEWPC 2012).

Location in the Goulburn Broken catchment

Natural Grasslands occur across the southern parts of the Riverina IBRA bioregion in NSW and Victoria, including plains across the northern part of the Goulburn Broken catchment. They predominately occur on flat, alluvial lowland plains with heavy-textured grey, brown and red clays.

In Victoria, a substantial part of the community is recognised as 'Northern Plains Grasslands', which is listed as threatened under the Victorian *Flora and Fauna Guarantee Act 1988*. The Northern Plains Grassland community is largely found in the North Central region of Victoria, near Patho, Mitiamo and Bael Bael. However, there are isolated occurrences in the Goulburn Broken region around Echuca, Tongala, Kyabram, Numurkah, and Corop. Key sites include Naringaningalook (Naring) Grassland, Numurkah Rifle Range, Odea's Rd, Tungamah Roadsides and Deviation Rd Corop (DSE 2006).

Most of the Natural Grasslands have been cleared, invaded by weeds, or otherwise degraded such that few remnants remain in good condition. Estimates suggests that approximately 5,374 ha may have occurred in the Goulburn Broken catchment and of this a mere 17 ha exists today i.e. less than 0.3% of its former distribution (DSE 2006). Most remaining patches occur as small and highly fragmented remnants on private land or roadsides where they are at risk of clearing or disturbance.

A map is included in Appendix 1, Figure 3.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Natural Grasslands of the Murray Valley Plains	Bushfire	Fire is necessary for the maintenance of some grasslands. Without fire or another disturbance dense grass can smother wildflowers, and result in a loss of habitat for native animals.	Low	The community responds well to appropriate fire regimes.
	Drought /Heatwaves	Long-term reduced rainfall in winter and spring from climate change may be a selection driver favouring more semi-arid species causing a shift in species composition and structure (DSEWPC 2012).	Low/medium	Changes in species composition and structure are expected from long-term climate change rather than single drought events.

Alpine Sphagnum Bogs and Associated Fens

Environment Protection and Biodiversity Conservation Act (1999) status – **Endangered**

Description

The 'Alpine Sphagnum Bogs and Associated Fens' ecological community (henceforth called Alpine Bogs) includes two distinct components of high mountain wetlands that are both restricted in area and typically occur together – bogs and fens. Although it is not always the dominant genus, the bogs component of the ecological community can usually be defined by the visual presence of Sphagnum spp. on a peat substratum. The fens are shallow, open water pools with or without emergent aquatic plants and are often near to or surrounded by bogs (DoE 2015).

Location in the Goulburn Broken catchment

Alpine Bogs are found in small pockets across alpine, subalpine and some montane areas of Tasmania, Victoria, NSW, and the ACT, as part of a mosaic of alpine communities with close hydrological and ecological connections. They typically occur in alpine, sub-alpine and montane (mountainous, or of higher elevation) environments, on gentle to moderate slopes amongst trees, in frost-prone valleys and plains, and sometimes above the climatic tree line (DEWHA 2008).

While most examples are situated within national parks, this community consists of highly fragmented, isolated remnants, and its present geographic extent is restricted. Within the Goulburn Broken catchment, Alpine Bogs are found in scattered patches at elevations of 800-1,600 metres about sea level within the upper catchments of the Rubicon, Howqua, and Jamieson Rivers. Mapping of known Alpine Bogs undertaken by the Victorian Government has identified occurrence of Alpine Bogs around Lake Mountain in the Yarra Ranges National Park, Mount Torbreck, Mount Bullfight, the Rubicon State Forest, and within the Alpine National Park around Mount Buller, Mount Stirling, Eagle Peaks, and Mount Howitt (DEPI 2012).

A map is included in Appendix 1, Figure 4.

Other considerations

Alpine Bogs support a number of threatened species, including two priority species within the Goulburn Broken catchment: Alpine Tree Frog (*Litoria verreauxii alpina*) and Alpine Bog Skink (*Pseudemoia cryodroma*). As these species are dependent on the Alpine Bog community, their susceptibility to threats associated with emergency scenarios are considered parallel. The estimated distributions of these species are shown on Figure 4, Appendix 1.

Victorian Alpine Peatland Spatial Action Plan

The Victorian Alpine Peatland Spatial Action Plan (VAPSAP) (McMahon, et al. 2015), facilitated by the Victorian Alpine Peatland Coordinating Committee, provides a cross-catchment, tenure-blind framework for the management of peatlands in the Victorian Alps. It identifies risks and threatening processes and establishes priority actions for peatlands across the Victorian Alps to strategically manage, protect, and enhance peatland values and ecological processes. Relevant threats to Alpine Peatlands described in the VAPSAP that also align with disaster scenarios have been included in this Plan.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Alpine Sphagnum Bogs and Associated Fens (Alpine Tree Frog, Alpine Bog Skink)	Bushfire	A reduction in vegetation cover within and adjoining alpine bogs and fens may result in changes in hydrological regimes and increase the risk of invasion by exotic species (DoE 2015). Removal of functionally important species such as sphagnum moss also impacts water holding capacity, water quality and erosion rates (DEWHA 2009).	High	Increased frequency or a single high intensity fire may result in permanent change to the structure and species composition of the community (DoE 2015). Climate change is expected to interact with drought and bushfire, creating hotter, drier weather more often. Peatlands rely on moisture for survival and become more prone to fire as they dry out.
	Drought /Heatwaves	Changes in snowfall and snowmelt regimes due to climate change affect groundwater and runoff patterns. Over time, a reduction in snowmelt and soil moisture is likely to result in this community being replaced by tussock grasslands or wet heath assemblages (DoE 2015).	Medium/high	Alpine Bogs occur at the climatic and elevational limits of their possible range and are therefore amongst the most vulnerable to the potential impacts of a changing climate (DoE 2015). The continued onset of climate-induced drought and increased temperatures is predicted to reduce the overall distribution of Alpine bog communities (McMahon, et al. 2015).

Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia

Environment Protection and Biodiversity Conservation Act (1999) status – **Endangered**

Description

The ‘Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia’ ecological community (henceforth called Grey Box Grassy Woodlands) is an open woodland with a tree

canopy dominated or co-dominated by grey box over an open to sparse ground layer of grasses and herbs. The listed community includes patches of derived grassland, where the tree canopy and mid layer has been removed to less than 10% crown cover, but the native ground layer remains largely intact (DEWHA 2010).

Location in the Goulburn Broken catchment

Grey Box Grassy Woodlands mostly occur from central NSW through northern Victoria into eastern South Australia. The community tends to occupy drier sites within the belt of grassy woodlands in south-eastern Australia with mean annual rainfall in the range 375-700 mm/year (DEWHA 2010).

Grey Box Grassy Woodlands are found in low-relief landscapes such as flat to undulating plains, low slopes and rises and, to a lesser extent, drainage depressions and flats. They may extend to more elevated hillslopes on the fringes of its range where they intergrade with other woodland or dry sclerophyll forest communities. In Victoria, Grey Box Grassy Woodlands often adjoin other plains communities including Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions (DEWHA 2010).

The historical extent of Grey Box Grassy Woodlands coincides with what is now the wheat-sheep belt of eastern Australia. Consequently, this community has suffered extensive clearing for agriculture because of its open, grassy structure and its association with relatively fertile soils (DEWHA 2010). Remnant patches within the Goulburn Broken catchment are largely concentrated on the productive agricultural plains north of the Hume Highway. Most remnant sites are on private land, although some are contained within conservation reserves and along road easements.

A map is included in Appendix 1, Figure 5.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Bushfire	Fire is necessary for the maintenance of some grasslands and grassy woodlands. Without fire or another disturbance, dense grass can smother wildflowers, and result in a loss of habitat for some native animals.	Low/medium	Considered low as these ecosystems need fire. However, the impact of repeated high-intensity fires boosts susceptibility to medium. Too frequent fire could threaten recruitment in slow to moderate growing eucalypts such as Yellow Box, Grey Box and White Box which may not reach reproductive maturity before the next fire. However, species can recover vegetatively so this may not pose as substantial a threat.
	Flood	Riverine flooding can impact these ecosystems through the spread of weeds.	Medium	Mapping indicates some remnants of this community occurs in floodplain areas in the catchment.
	Drought /Heatwaves	This community exhibits some resilience to drought (DSEWPC 2012). However, lack of long-term rainfall is likely to contribute to reductions in extent, changed species composition, loss of species diversity due to fragmentation and isolation of remnants and changes in understorey structure.	Low/medium	Impacts are based on climate-change predictions.

Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregion

Environment Protection and Biodiversity Conservation Act (1999) status – **Endangered**

Description

The 'Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions' ecological community (henceforth called Buloke Woodlands) includes several closely related woodland communities where Buloke (*Allocasuarina luehmannii*) is usually a dominant or co-dominant tree. Other trees that may be prominent include Slender Pine (*Callitris gracilis*), White/Murray Pine (*Callitris glaucophylla*), Black Box (*Eucalyptus largiflorens*), Yellow/Blue Gum (*Eucalyptus leucoxylon subsp. pruinosa*) and Grey Box (*Eucalyptus microcarpa*) (Cheal 2011).

Location in the Goulburn Broken catchment

Buloke Woodlands were formerly widespread across the riverine plains of the Murray Darling Depression and Riverina bioregions. Progressive clearing and additional threats from pest plants and animals, particularly rabbits, have seen these woodlands decline in extent and condition. Remnants occur from south-eastern South Australia through north-western Victoria to the eastern borders of the Riverina bioregion (Cheal 2011).

In Victoria, the community corresponds with components of 'Grey Box-Buloke Grassy Woodlands', which is listed as threatened under the Victorian *Flora and Fauna Guarantee Act 1988*. Grey Box-Buloke Grassy Woodlands occur as fragmented remnant patches across the non-flooding plains of the Goulburn Broken catchment, around Murchison, Violet Town, Nagambie, Katamatite, Nathalia, and Numurkah. Key sites include the Balmattum Grassy Woodland Reserve, Wunghnu Bushland Reserve, Yielima Bushland Reserve, and the Broken-Boosey State Park (DSE 2006).

Buloke Woodlands historically occurred in a mosaic pattern across the landscape, interspersed amongst grasslands and eucalypt woodlands. Within the Goulburn Broken catchment, they adjoin and share associations with other threatened and culturally important ecological communities such as Sand Ridge Woodlands.

A map is included in Appendix 1, Figure 6.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions	Bushfire	High-intensity fire can kill large trees and change the species composition of woodlands.	Medium/high	Fire of sufficient intensity can lead to a catastrophic change from woodland of Pine and/or Buloke to herb/grassland. Grazing by pests and stock following fire can exacerbate the impact. Some woodlands lack understorey so have lower susceptibility to fire.
	Drought /Heatwaves	Buloke may require high autumn rainfall for regeneration from seed. Reduction in autumn rainfall has resulted in severe canopy decline across the region, and cool season rainfall is projected to decline further due to climate change. The stress of continuing dry conditions also leads to dramatic decline in old trees (DCCEEW 2023).	High	Buloke Woodlands (Sands) rely on suitable soil moisture in autumn to regenerate from seed. Many of the woodlands in the catchment require either high rainfall or floods for this to be realised.
	Flood	Cultural sites and ecological communities adjacent to or associated with this community (e.g. Sand Ridge Woodland) are vulnerable to flood events and flood response actions (J Whittaker pers. comm. 2024).	Medium	Sites have been damaged during past flood events (e.g. 2022).

Barmah Forest Ramsar Site

Description

The Barmah Forest Ramsar site was listed as a wetland of international importance under the Ramsar Convention in 1982. Together with the adjoining Millewa Forest in NSW, it forms the most extensive floodplain wetland complex on the Murray River and supports the largest continuous River Red Gum (*Eucalyptus camaldulensis*) forest in Australia.

Location in the Goulburn Broken catchment

The Barmah Forest Ramsar site is located on the northern boundary of the Goulburn Broken catchment on the Murray River. It consists of the section of the Murray River floodplain within Victoria (i.e. south of the main river channel) between the downstream end of Ulupna Island and Barmah Township, covering approximately 28,515 hectares. Inundation of the site is largely driven by flows within the Murray River (Hale and Butcher 2011).

The location of the Barmah Forest Ramsar site is shown in Figure 7, Appendix 1.

Other considerations

Complex interrelationships exist between the critical components, processes, and services which form the Barmah Forest Ramsar site. Cycles of wetting and drying are fundamental to the floodplain ecosystem. The duration, seasonality, frequency, and intensity of wetting and drying determines the type of biota that occurs, and wetting and drying can provide important cues for flora and fauna in reproductive cycles (Hale and Butcher 2011).

While the majority of the Barmah Forest Ramsar site is a tree-dominated wetland, it also contains a variety of other types of permanent and seasonal wetlands including lakes, reed dominated swamps, marshes, and lagoons. The site has the most extensive Moira Grass plains in the Murray-Darling Basin and supports a range of threatened species that depend on the healthy function of the floodplain including the Australasian Bittern, Superb Parrot, Murray Cod and Trout Cod. The site is an important breeding area for several Ibis species, and following flooding it is one of Victoria's largest breeding areas for waterfowl.

Yorta Yorta people continue a timeless connection to their ancestral lands, including the rich network of rivers, forests, and wetlands around what we now refer to as the Murray River and Goulburn River floodplains. The Barmah Forest Ramsar site holds a wealth of cultural sites and features which form part of the living history of the Yorta Yorta people, as well as totemic species such as the Broad-shelled Turtle.

The Barmah National Park, which has mostly overlapped boundaries with the Ramsar site, is jointly managed by the Yorta Yorta Nation Aboriginal Corporation and Parks Victoria under a Traditional Owner Land Management Agreement with the State of Victoria. The Joint Management Plan 2020 outlines aspirations of the partnership and sets objectives for sustainable management of the park, under the broad vision of: *Heal the Land, Heal the People – Healthy Country*.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Barmah Forest Ramsar Site	Bushfire	Increased frequency and intensity of bushfires has potential to decrease vegetation health or alter vegetation community structure and composition, particularly if fires follow drought. River Red Gum saplings are fire sensitive and mature trees may be threatened by moderate or high intensity fires (Hale and Butcher 2011).	Medium	Key vegetation communities are known to be vulnerable to fires, particularly following drought. Repeated fire could impact the ability for these communities to regenerate.
	Drought /Heatwaves	The hydrology of the site is highly regulated, and seasonality of low and moderate flow in the Murray River is determined largely by irrigation needs. Large scale floods that inundate the forest are generally the	Medium	Almost all modelled climate change scenarios predict an increase in the interval between flooding of the Barmah Forest Ramsar site. While

		result of catchment scale rainfall events. Projected decreases in rainfall due to climate change would decrease frequency and duration of floodplain and wetland inundation. This is likely to exacerbate the effects of river regulation already observed at the site with an increase in stress to vegetation and fauna communities (Hale and Butcher 2011).		the site has previously shown capacity to recover following drought, the cumulative effect of other climate change related processes (e.g. increased temperatures, bushfire) may threaten this capacity.

Threatened Species

Threatened Fish Species

Description

Rivers and wetlands within the Goulburn Broken catchment support several national and state listed threatened fish species. Seven species are listed under the EPBC Act 1999: Flat-headed Galaxias and Silver Perch (critically endangered); Barred Galaxias, Trout Cod, and Macquarie Perch (endangered), Murray Cod and Southern Pygmy Perch (vulnerable). Of note amongst state listed threatened fish is the Southern Purple-spotted Gudgeon, which was thought to be extinct in Victoria until it was re-discovered in 2019. While there are no known wild populations of Southern Purple-spotted Gudgeon within the Goulburn Broken catchment, this species has recently been translocated to farm dams and wetlands within the region.

Threatened fish species are solely dependent waterways in good condition. Waterway condition is a product of hydrology, water quality, streamside vegetation, bed and bank condition, instream habitat and aquatic macroinvertebrate diversity. Instream structures such as rocks, submerged logs, and branches (snags), vegetation and deep pools or undercut banks, provides fish with places to shelter and breed.

Many threatened fish species now persist only in small patches of remnant habitat dominated by human influences. As such, management activities generally aim to protect these patches from threats, help build connectivity between patches, and to ultimately increase the size and number of populations to reduce the risk of extinction (GB CMA 2014).

There are knowledge gaps about the processes that limit the distribution and abundance of threatened species populations. In recent years, monitoring in the Goulburn Broken catchment has focused on known populations (presence, numbers, and diversity) and assessing the impact of management actions (i.e. fishways, habitat restoration and delivery of environmental water). Hence, there is increased knowledge on populations where monitoring has been undertaken (GB CMA 2014).

Refer to distribution notes in table below. A map is also included in Appendix 1, Figure 8.

Common name	**Scientific name**	***Environment Protection and Biodiversity Conservation Act* (1999) status**	***Flora and Fauna Guarantee Act* (1988) status**	***Distribution notes***
Flat-headed Galaxias	*Galaxias rostratus*	Critically Endangered	Vulnerable	Two isolated sites (dams) west of Mitchelton, a wetland on the Goulburn River Floodplain on the mid Goulburn River near Alexandra.
Silver Perch	*Bidyanus bidyanus*	Critically Endangered	Endangered	Small numbers in the lower Goulburn River, lower Broken River, and Lower Broken creek.
Barred Galaxias	*Galaxias fuscus*	Endangered	Critically Endangered	Restricted to upper reaches of approximately 20 headwater streams.
Trout Cod	*Maccullochella macquariensis*	Endangered	Endangered	Lower Goulburn River, mid Goulburn River, and an isolated population in the Seven Creeks.

Common name	Scientific name	*Environment Protection and Biodiversity Conservation Act* (1999) status	*Flora and Fauna Guarantee Act* (1988) status	*Distribution notes*
Macquarie Perch	*Macquaria australasica*	Endangered	Endangered	Seven Creeks, Hughes Creek, King Parrot Creek, Hollands Creek, Yea River, Broken River, and the mid Goulburn River.
Murray Cod	*Maccullochella peelii*	Vulnerable	Endangered	Key waterways include the lower Goulburn River, mid Goulburn River, Broken River, and Broken Creek.
Southern Pygmy Perch (Murray-Darling lineage)	*Nannoperca australis (Murray-Darling lineage)*	Vulnerable	Vulnerable	Broken River (reach downstream of the Lake Nillahcootie), upper Castle Creek, Hughes Creek (and possibly other waterways in in the Strathbogie Ranges), McLarty's Lagoon (translocated), and Winton Wetlands (translocated).

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Threatened fish species	Bushfire	Bushfires can severely degrade water quality. Sediment, ash, and debris from burnt areas affect both the short and long-term physical and chemical make-up of freshwater systems (DCCEEW 2024).	Medium/ high	Where priority habitat is located within a regulated river, environmental water can be delivered to help improve water quality and maintain suitable habitat.
	Drought	Receding water levels may limit access to different types/areas of habitat and food resources. Low water levels can leave fish stranded in isolated pools with poor water conditions such as blue-green algae or low dissolved oxygen. Drought conditions may also reduce instream water quality and cause changes in riparian vegetation structure.	High	Species are adapted to varying degrees to cope with drought. However, prolonged drought combined with other climate change related impacts (e.g. bushfires) may push some beyond their limits. Environmental water allocations support sustaining fish populations during drought.
	Heatwave	Heatwave events can result in elevated water temperature resulting in reduced dissolved oxygen concentrations, impacting aquatic dependent species. Coupled with low water levels, storm, or flood event, blackwater may result.	Medium	Low dissolved oxygen and/or blackwater events have high probability in resulting in fish deaths, there is opportunity to improve water quality and provide habitat in regulated systems where environmental water is available. This has been successful in the past, although with limitations.
	Flood	Flood events may wash hypoxic blackwater into waterways caused by the breakdown of organic material within the catchment. The	High	Floods can provide a range of benefits to freshwater fish. However, blackwater events may more

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
		hypoxic conditions may lead to fish deaths.		frequently follow floods currently, and under climate change scenarios. Where priority habitat is located within a regulated river, environmental water can be delivered to help maintain suitable habitat, although with limitations.

Swift Parrot *(Lathamus discolor)*

Environment Protection and Biodiversity Conservation Act (1999) status – **Critically Endangered**

Flora and Fauna Guarantee Act (1988) status – **Critically Endangered**

Description

The Swift Parrot is a slim, medium-sized parrot with a streamlined shape in flight, angular pointed wings and a long, pointed purple-red tail. The body is mostly bright green, with a dark-blue patch on the crown. The forehead to throat is crimson and there is a crimson patch at the bend of the wing. The female is slightly duller, with a creamy underwing bar. In flight, the bright-green body, dark flight feathers and scarlet underwing coverts are prominent. Swift Parrots are noisy and active, with a very fast, direct flight (BirdLife Australia 2024).

Habitat

The Swift Parrot is endemic to south-eastern Australia and breeds only in Tasmania. During the non-breeding season, it migrates to the mainland where it occurs mainly in southern and central Victoria and in eastern New South Wales. The most recent assessment for the species indicates a population size of approximately 750 mature individuals, down from 2,000 individuals in the early 2000s. This represents a population decline of more than 60% since the previous 2011 estimate (BirdLife Australia 2024).

In Victoria, Swift Parrots are predominantly found in the dry forests and woodlands of the box-ironbark region on the inland slopes of the Great Dividing Range. The most frequently used regions include the broad area between Bendigo, Stawell, and St Arnaud; the forests and woodlands between Rushworth and Heathcote; and north-east Victoria around the Warby-Ovens and Chiltern-Mt Pilot National Parks (Mowat, et al. 2021).

Swift Parrots are primarily nectar feeders, preferring nectar from flowering *Eucalyptus spp*. The remnant box-ironbark systems in the Goulburn Broken catchment area form an important part of what remains of optimal, habitat found across the species' non-breeding range.

Management actions to protect Swift Parrot habitat will have secondary benefits for threatened ecological communities including 'Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia' and 'White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.'

Priority locations in the Goulburn Broken catchment

The National Recovery Plan for the Swift Parrot identifies priority habitat for protection and management that includes several areas of box-ironbark forest and woodland within the Goulburn Broken catchment (Saunders and Tzaros 2011).

Most suitable habitat types occur outside formal conservation reserves. Key sites include Warby Ovens National Park and the Killawarra Forest, Cussen Park Tatura, Nagambie Heathcote-Graytown National Park, Whroo State Forest, Costerfield State Forest, Rushworth State Forest, and Dookie Bushland Reserve.

The Goulburn Broken catchment contains 15 fixed monitoring sites as part of BirdLife Australia's Swift Parrot Search. This is a standardised, citizen science program that initially began in the 1990s to monitor the movement and locations of the Swift parrot and Regent Honeyeater.

A map is included in Appendix 1, Figure 9.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Swift Parrot	Bushfire	Increased fire frequency and intensity is a notable threat to the Swift Parrot across its range. Eucalypt flowering frequency, nectar output, and maturation of nectar-rich plant species can be reduced where fire frequency is too regular or intense, resulting in reduced foraging resources. Tree mortality can also occur and is likely in these conditions, particularly among large trees, which typically provide more reliable and sustained flowering events.	Low/medium	A single cooler fire is likely to have a negligible effect. There could be catastrophic loss of habitat from intense fires, as habitat is restricted and fragmented. A severe wildfire that destroys the canopy would remove foraging opportunities.
	Drought	Foraging resources are scarce during drought, causing Swift Parrots to concentrate in urban areas to forage on remnant and planted eucalypts. This can increase competition for limited resources and exacerbate threats associated with urban areas e.g. collision with netting/windows/cars, and predation by cats.	Low	The species tends to concentrate in coastal drought refuge habitats in New South Wales, which can support larger numbers of birds when inland habitats are subjected to drought (Saunders and Tzaros 2011).

Regent Honeyeater *(Anthochaera phrygia)*

Environment Protection and Biodiversity Conservation Act (1999) status – **Critically Endangered**

Flora and Fauna Guarantee Act (1988) status – **Critically Endangered**

Description

The Regent Honeyeater is a medium-sized honeyeater. Plumage is predominantly black with bright yellow edges along the tail and wing feathers, with body feathers broadly edged in pale yellow or white. A large patch of yellowish to pinkish, bare, warty skin surrounds each eye. The overall visual impression is of a blackish bird boldly embroidered with yellow and white, with brilliant yellow flashes in the wings and tail. Juvenile Regent Honeyeaters look very different to adults, with generally plain brown body feathers and narrow white or pale-yellow edges on their flight feathers (in contrast to the bright yellow of adults) (DoE 2016).

Habitat

Formerly distributed throughout the temperate forests and woodlands of south-eastern Australia, Regent Honeyeater distribution is now extremely patchy with a small number of known breeding sites. Most records are associated with box-ironbark eucalypt vegetation, where the species seems to frequent more fertile sites with higher soil water content, including creek flats, broad river valleys and lower slopes.

Priority locations in the Goulburn Broken catchment

The National Recovery Plan for the Regent Honeyeater identifies the remnant box-ironbark systems around the Lurg-Benalla Region in the Goulburn Broken catchment area as priority locations of what remains of optimal, remnant habitat found across the species range. Key sites include remnants within the Benalla Shire Vegetation Protection Overlay, Kelly's Gap, Winton Wetlands, the Killawarra Forest, and locations around Wangaratta South. Remnant stands of timber, roadside reserves, travelling stock routes and street trees also provide important habitat.

The Regent Honeyeater Project has been in operation in the Lurg Hills near Benalla for over 25 years. This Project is recognised as one of the most active volunteer conservation projects in Australia. Over 700,000 seedlings have been planted and nearly 1,800 hectares of habitat have been restored across 450 sites, the majority on private land.

A map is included in Appendix 1, Figure 10.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Regent Honeyeater	Bushfire	Increased fire frequency and intensity is a notable threat to the Regent Honeyeater across its range. Eucalypt flowering frequency, nectar output, and maturation of nectar-rich plant species can be reduced where fire frequency is too regular or intense, resulting in reduced foraging resources. Tree mortality can also occur and is likely in these conditions, particularly among large trees, which typically provide more reliable and sustained flowering events.	Low/medium	A single cooler fire is likely to have a negligible effect. There could be catastrophic loss of habitat from intense or frequent fires, as habitat is restricted and fragmented. A severe wildfire that destroys the canopy would remove foraging opportunities.
	Drought	Foraging resources are scarce during drought, causing Regent Honeyeaters to concentrate in urban areas to forage on remnant and planted eucalypts. This can increase competition for limited resources and exacerbate threats associated with urban areas e.g. collision with netting/windows/cars, and predation by cats. Drought-induced stress can also lead to mortality of mature trees.	Low/medium	The species has some capacity to move to drought refuge habitats if resources become scarce in particular areas.

Leadbeater's Possum *(Gymnobelideus leadbeateri)*

Environment Protection and Biodiversity Conservation Act (1999) status – **Critically Endangered**

Flora and Fauna Guarantee Act (1988) status – **Critically Endangered**

Description

Leadbeater's Possum is a small, nocturnal, arboreal possum. It has some superficial resemblance to the more abundant and widespread Sugar Glider (*Petaurus breviceps*) but is notably distinct from that species in not possessing a gliding membrane and having a club-shaped tail. Leadbeater's possum is the only mammal species that is endemic to Victoria and has become a flagship species for conservation of its montane ash forest habitat (DCCEEW 2024).

Habitat

The historical distribution of Leadbeater's Possum is poorly known. Almost all recent records of Leadbeater's Possum have been within the montane ash forests of the Central Highlands of Victoria. Within its main range, its distribution is patchy and dependant on the presence of critical habitat features.

Habitat features required by Leadbeater's Possum include large tree hollows for breeding, continuous foliage cover to facilitate movement, and a forest composition that includes gum-producing wattles and habitat for invertebrate prey. The extent, quality, and connectivity of Leadbeater's possum habitat in montane ash forest is undergoing severe ongoing decline due to changing fire regimes, timber harvesting, and ongoing habitat fragmentation (DCCEEW 2024).

Priority locations in the Goulburn Broken catchment

The National Recovery Plan for the Leadbeater's Possum identifies priority habitat for protection and management that includes montane ash forest in the Snobs Creek, Mt Bullfight, and Rubicon areas of the Goulburn Broken catchment. The Mount Bullfight plateau supports an important population in sub-alpine woodland, and modelling also suggested that parts of Toolangi State Forest are strongholds for the species (DEPI 2014). There have also been records within Snow Gum (*Eucalyptus pauciflora*) sub-alpine woodland at Lake Mountain (DCCEEW 2024).

The 2009 Kilmore-Murrindindi fire had a significant impact on the distribution of the species. Models predict that the current distribution of the species is centred on unburnt habitat in the southern parts of the Central Highlands. Sites most likely to be occupied are lush, unburnt vegetation in gullies located in areas with relatively low summer temperatures and high summer rainfall (Lumsden, et al. 2013).

A map is included in Appendix 1, Figure 11.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Leadbeater's Possum	Bushfire	Increased fire frequency and intensity is a notable threat to the Leadbeater's Possum across its range. Eucalypt flowering frequency, nectar output, and maturation of nectar-rich plant species can be reduced where fire frequency is too regular or intense, resulting in reduced foraging resources. Tree mortality can also occur and is likely in these conditions, particularly among large, hollow-bearing trees, which provide important habitat (DCCEEW 2024).	Low/medium	A single cooler fire is likely to have a negligible effect. There could be catastrophic loss of habitat from intense fires, as habitat is restricted and fragmented. A severe wildfire that destroys the canopy would remove foraging opportunities.
	Drought/ Heatwave	As Leadbeater's Possum occurs in areas characterised by cold, wet climates with relatively low summer temperatures and high summer rainfall, a hotter and drier climate may reduce the area of suitable habitat available for the species. Higher mortality rates of hollow-bearing trees have previously been observed during periods of low rainfall, potentially due to moisture stress. Increased frequency of drought could further exacerbate the loss of hollow-bearing trees in the future (DEPI 2014).	Low/medium	Impacts are based on climate-change predictions.

Spotted Tree Frog *(Litoria spenceri)*

Environment Protection and Biodiversity Conservation Act (1999) status – **Critically Endangered**

Flora and Fauna Guarantee Act (1988) status – **Critically Endangered**

Description

The Spotted Tree Frog, which grows between 50-60 mm in length, has a back which ranges in colour from pale brown to bright green to olive-grey, usually with numerous raised small 'warts'. In contrast its underbelly is pale and granular, and often flushed with pale orange toward the rear and underside of the hind limbs.

Habitat

Only 12 populations have been located in Victoria; these occur predominantly to the north-western side of the Great Dividing Range, between the Central Highlands of Victoria and Mt Kosciusko in NSW. Spotted Tree Frogs inhabit naturally vegetated, rocky, swift-flowing upland streams in dissected mountainous country, between 280 and 1110 metres above sea level. The species is highly susceptible to disease, impacts of non-native fish, and habitat disturbance (Gillespie and Robertson 1998).

Spotted Tree Frogs have disappeared from 50% of known historic sites, are rare at all remaining sites and are expected to become extinct without intervention. Zoos Victoria and partners including the Goulburn Broken CMA were involved in releasing 70 frogs in the Big River catchment in February 2024 and monitoring their release (Zoos Victoria 2024).

Priority locations in the Goulburn Broken catchment

The Goulburn Broken catchment contains isolated populations of Spotted Tree Frog in streams south-east and east of Eildon. These include the Still & White Creeks, Taponga River, Big River (Eildon), headers waters of the Goulburn River near Woods Point, Snake Creek and tributaries, Jamieson River (north branch), and Howqua River.

A map is included in Appendix 1, Figure 12.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Spotted Tree Frog	Bushfire	Bushfires can severely degrade water quality. Sediment, ash, and debris from burnt areas affect both the short and long-term physical and chemical make-up of streams. Increases in sediment levels following bushfire may affect egg-deposition or tadpole survival (Gillespie and Robertson 1998). The small size and isolation of these populations exposes them to risk of extinction from stochastic events, with little chance of natural recolonisation.	Medium/high	Populations have become extinct in the past and may do so in the future if inappropriate levels of disturbance are allowed.
	Drought/ Heatwave	Reduced rainfall may affect flow rates in streams, which may affect the viability of eggs or the survival of tadpoles (Gillespie and Robertson 1998).	Medium	Small size and isolation of remaining populations increases vulnerability to repeated or prolonged drought.
	Flooding	High rainfall especially after fire or drought can cause hypoxic blackwater events. This can affect egg and tadpole survival. Flooding can also increase non-native fish abundance in Spotted Tree Frog habitat increasing the risk of predation.	Medium/high	Populations have become extinct in the past and are vulnerable in these types of events.

Round-leaf Pomaderris *(Pomaderris vacciniifolia)*

Environment Protection and Biodiversity Conservation Act (1999) status – **Critically Endangered**

Flora and Fauna Guarantee Act (1988) status – **Critically Endangered**

Description

Round-leaf Pomaderris is a slender shrub growing 1-6 metres high. It has elliptic leaves 1-2 cm long, with a smooth upper surface and a lower surface that is white from a dense layer of minute hairs. The flowers are small and creamy white and occur in the leaf axil.

Habitat

Round-leaf Pomaderris is endemic to Victoria where is occurs in the middle and upper catchments of the Yarra River, extending marginally north into the headwaters of the Yea River and King Parrot Creek. Its distribution is highly restricted and is known from about 33 populations with an estimated total number of 250 mature individuals (DoE 2014).

Priority locations in the Goulburn Broken catchment

Within the Goulburn Broken catchment, isolated populations of Round-leaf Pomaderris are known to occur in montane forests around Kinglake, Castella, and Toolangi. There is also a healthy population within Kinglake National Park. Known populations were severely impacted by Black Saturday fires in 2009 but are thought to be recovering well (Nillumbik Shire Council 2024).

A map is included in Appendix 1, Figure 13.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Round-leaf Pomaderris	Bushfire	Inappropriate fire regimes can cause mortality and/or affect reproductive success. The species is threatened by both repeated fires at intervals shorter than 10 years, and prolonged exclusion of fire for more than 20-25 years (DEECA 2023). The small size and distribution of known populations exposes them to risk of extinction from bushfires.	Low/medium	Evidence of recovery following Black Saturday bushfires (Nillumbik Shire Council 2024).
	Drought	Prolonged drought stress may cause adult mortality, affect reproductive success, and lead to recruitment failure (DEECA 2023).	Low	Effects are not well understood. However, restricted distribution and small population size increases vulnerability to repeated or prolonged drought.

Spiny Rice-flower (*Pimelea spinescens subsp. spinescens*)

Environment Protection and Biodiversity Conservation Act (1999) status – **Critically Endangered**

Flora and Fauna Guarantee Act (1988) status – **Critically Endangered**

Description

Spiny Rice-flower is a stunted shrub, 5-50 cm in height. The stems may be partly herbaceous and are often tipped by a small spin. The leaves are narrow, green, hairless, and oval-shaped. Its pale-yellow flowers are often found on short branchlets.

Habitat

Spiny Rice-flower is a sub-shrub endemic to grasslands and grassy woodlands in Victoria, with the southwest being an important area for survival and recovery. Approximately 90% of the population occurs in the Victorian Volcanic Plains bioregion, the remaining populations occur in the western part of the Midlands and Riverina bioregions. Plants in the northerly range appear to differ in their habitat, occurring on alluvial soils, red clay complexes, beneath an open tree canopy (DSE 2008).

Priority locations in the Goulburn Broken catchment

Within the Goulburn Broken catchment there are only a small number of records of Spiny Rice-flower, along the Tait Hamilton Road near Gobarup Creek, just east of Gobarup. However, the mapped indicative distribution of the species covers a much larger area within the catchment. More recent discoveries of new populations in Grassy Woodland habitats near Bendigo suggest that refugia may exist in parts of the Goldfields and possibly other adjacent bioregions (DSE 2005).

A map is included in Appendix 1, Figure 14.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Spiny Rice-flower	Bushfire	For Spiny Rice-flower and many other grassland species, fire can support their persistence.	Low	Appropriate fire regimes appear to provide germination

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
		Spiny Rice-flower possesses traits sensitive to low fire frequency: short-lived seed bank, and low seed-dispersal range. Frequent fires may cause a decline in this species. Mortality of existing plants or removal of reproductive output (soil seed bank) may also occur if fires occur during flowering seasons (DCCEEW 2022).		and recruitment opportunities, but it is unknown whether these observations apply to northern (Riverina) populations, as these are not known to have been burnt/disturbed (DSE 2005).

Australasian Bittern (*Botaurus poiciloptilus*)

Environment Protection and Biodiversity Conservation Act (1999) status – **Endangered**

Flora and Fauna Guarantee Act (1988) status – **Critically Endangered**

Description

The Australasian Bittern is a heavy-set, partially nocturnal heron with upper parts patterned dark brown, buff, and black, and underparts streaked brown and buff. The eyebrow and throat are pale, and the side of the neck is dark brown. The bill is brown, the legs greenish, and the average size is 71 cm. It resembles an owl in flight, with broad wings that beat slowly, steadily, and shallowly with dangling legs on take-off (BirdLife Australia 2024).

Habitat

Australasian Bitterns occur mainly in freshwater wetlands in temperate southeast and southwest of Australia. Their preferred habitat is densely vegetated wetlands, especially where there is a mosaic of cover, from 0.5–3.5 metres in height. Here they forage in still, shallow water up to 0.3m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. They favour permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and/or reeds (e.g. *Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus*) or cutting grass (*Gahnia*) growing over a muddy or peaty substrate, as well as rice crops (DCCEEW 2022).

Priority locations in the Goulburn Broken catchment

Australasian Bitterns are thought to have been historically more widespread within the Goulburn Broken catchment. Their distribution now appears to be contracted to larger wetlands on the Murray River floodplain, including several within Barmah National Park which provide critical habitat for the species. A monitoring program for the species has been established within Barmah National Park to increase knowledge on their location and abundance within the park (Belcher, et al. 2018).

A map is included in Appendix 1, Figure 15.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Australasian Bittern	Drought (Heatwave)	A combination of drought and river regulation reducing natural water flows can impact wetland health and vegetation which in turn impacts the Australasian Bittern (DCCEEW 2022).	Low/medium	Environmental watering in the Barmah Forest has supported significant numbers of Australasian Bitterns, with confirmed breeding (DCCEEW 2022).
	Bushfire	Intense and frequent bushfires in wetlands can alter the density and cover of vegetation that forms the core habitat of the Australasian Bittern, potentially resulting in reduced nesting success (DEE 2019).	Low/medium	Individual wetlands may require different fire regimes depending on vegetation type and location. Appropriate patch burning techniques have potential to enhance

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
				habitat for the Australasian Bittern, encourage the regeneration of native plant species and support cultural practices (DCCEEW 2022).

Mountain Pygmy-possum (*Burramys parvus*)

Environment Protection and Biodiversity Conservation Act (1999) status – **Endangered**

Flora and Fauna Guarantee Act (1988) status – **Endangered**

Description

The Mountain Pygmy-possum is the largest of the five species of pygmy-possum (Family Burramyidae). It has a head-body length of 10–11 cm, a tail length of 13–15 cm and adults weigh from 35–80 g. The dorsal fur is uniformly mid-grey, tinged brown, with cream or fawn underparts and cheeks. Conspicuous black patches surround the dark, round eyes, and the tail is thin and pinkish grey (DEE 2018).

Habitat

The Mountain Pygmy-possum is the only Australian mammal restricted to alpine and sub-alpine environments. The species now occurs in three geographically separate regions: Kosciuszko National Park (South Ramshead to Cabramurra) in NSW, Mount Bogong to Mount Higginbotham and Mount Buller in Victoria. These three groups are effectively isolated from one another by low elevation valleys containing unsuitable habitat for the species.

The species is largely confined to naturally occurring boulderfields and rock screes in alpine and subalpine areas at altitudes above 1400 metres above sea level. The boulders provide shelter, sites for hibernation and seasonal food sources. Rock crevices are used as summer aestivation sites for migratory Debera, Bogong Moths (*Agrotis infusa)*, an important food source of the Mountain Pygmy-possum and a species of high cultural importance to Taungurung people. The preferred boulderfield habitat is also strongly associated with alpine shrubby heathland, which supplies nectar in spring and summer, seeds and fruit in autumn and a substrate for a variety of arthropods included in the diet (DELWP 2016).

Priority locations in the Goulburn Broken catchment

All populations and sub-populations of the Mountain Pygmy-possum are considered important to the survival of the species and its adaptive potential (DELWP 2016). At Mount Buller the entire population of the Mountain Pygmy-possum occurs inside the Mount Buller and Mount Stirling Alpine Resort. Development for skiing had been occurring in the region for several decades prior to the discovery of the species on Mount Buller in 1996, leading to significant habitat loss, modification, and fragmentation of once connected habitats. There are approximately 230 hectares of Mountain Pygmy-possum habitat on Mount Buller, with the most optimal habitat located on the southern slopes (ARMB 2013).

A map is included in Appendix 1, Figure 16.

Other considerations

The Mountain Pygmy-possum is particularly reliant on two food resources that are heavily impacted by bushfire and drought: Bogong Moths (*Agrotis infusa*) and Mountain Plum-pine (*Podocarpus lawrencei*), and susceptible to climate change, being reliant on consistent snow cover to provide shelter for hibernation during winter months (DEE 2018).

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Mountain Pygmy-possum	Bushfire	Vegetation within Mountain Pygmy-possum habitat is highly sensitive to fire and is very slow to regenerate after being burnt or scorched. Particularly affected are the long-lived and slow-growing	High	The species is only known to occur across three small geographical areas. The core habitats of local populations and

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
		Mountain plum-pine, together with other heath species that form the protective cover and food-producing elements of the species' habitat. Loss of vegetation removes cover, food sources and movement corridors (DELWP 2016). The habitat of all Victorian populations was impacted by bushfire in 2003 and/or 2007. Recovery of Mountain Pygmy-possums in previously burnt areas has been variable but in some cases, fires have led to declines. It is considered critical that no Mountain Pygmy-possum habitat is burnt on Mount Buller, and protection of habitat is prioritised through the Mount Buller Recovery Plan (ARMB 2013).		are often restricted to alpine boulder field and associated/adjoining heathland habitats. This places them at risk of stochastic events such as bushfires. Bushfire can impact the core habitat, but also non-boulder field heathland habitat which connects local populations allowing for movement and dispersal of individuals as part of a meta-population (D Heinze, pers. comm 2024).
	Drought	Prolonged drought is linked to lower Bogong Moth numbers and reduced growth of plants reducing availability of food resources for the Mountain Pygmy-possum. Drought years are often associated with less snow cover which can increase the risk of predation and place possums under metabolic stress by compromising winter hibernation refuges in sub-nivean spaces (DELWP 2016).	High	Drought can dramatically reduce the availability of critical food resources (Bogong Moths) and impair winter hibernation. The impact of drought in the Bogong Moths breeding habitats (inland NSW and QLD) can also critically impact this species even if there is no drought in the alpine region. Any effects of drought are considered highly impactful.
	Heatwave	Time of formation, depth, duration of snow cover and time of snow melt strongly influence survival and recruitment of Mountain Pygmy-possums in its natural environment. High temperature spikes in winter that cause snow melt and rain events may disrupt hibernation, resulting in increased energy demand, winter mortality and potentially reduced reproductive success. Higher and more frequent extreme summer temperatures may also cause heat stress (DELWP 2016).	Medium	The ability of the Mountain Pygmy-possum to adapt to the range of changes predicted with climate change will depend on how tightly the species is tied to its current highly seasonal phenology, and its physical and behavioural plasticity (DELWP 2016).

Stiff Groundsel (*Senecio behrianus*)

Environment Protection and Biodiversity Conservation Act (1999) status – **Endangered**

Flora and Fauna Guarantee Act (1988) status – **Critically Endangered**

Description

The Stiff Groundsel is an erect, woolly perennial plant growing to about one metre high. Plants form extensive rhizomatous clumps. Leaves are grey-green, alternate, linear, about 25 mm long (the upper ones shorter) with the margins rolled under. The tiny yellow flowers occur in loose clusters at the ends of the stems.

Habitat

Stiff Groundsel was once widespread on the floodplains of the Murray-Darling River system. Having suffered widespread decline in distribution and abundance, the species is now restricted to five wild and two reintroduced populations in Victoria. All wild populations are small, <0.25 ha in size.

Remaining populations grow on poorly drained sedimentary grey clays or sandy clays on or close to floodplains, and on basalt-derived grey cracking clays in periodically flooded depressions. A common feature seems to be that habitats are seasonally inundated, and hydrological regime is probably an important aspect of habitat, although the optimal timing and extent of flooding are unknown (Nevill and Camilleri 2010).

Priority locations in the Goulburn Broken catchment

Occurrence of Stiff Groundsel within the Goulburn Broken catchment is restricted to six populations within the Corop Lakes area in the north-west part of the catchment. The four wild populations are located on road reserves and private land. Campaspe Shite Council manages existing wild roadside and private land populations through fencing, signposting, and including them on local government planning overlays. The two planted populations contained within Two Tree Swamp and Wallenjoe Swamp have struggled to establish (Nevill and Camilleri 2010).

A map is included in Appendix 1, Figure 17.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Stiff Groundsel	Bushfire	While it appears that fire may have an important role to play in the life cycle of Stiff Groundsel, fires that are too frequent, too intense, or that occur at a vulnerable growth stage of the species may affect long-term survival (Nevill and Camilleri 2010).	Low/medium	Relationship with fire is poorly understood.
	Drought	Timing, depth, and duration of inundation appear to be important in the growth of Stiff Groundsel. At both wild and reintroduced sites, plant growth appears to be more prolific in areas that are flooded to a depth of 30 cm or more. Recruitment from seed may depend upon suitable conditions, which may be impacted by drought or altered hydrology (Nevill and Camilleri 2010).	Low	As the habitat of Stiff Groundsel has been altered so much, it is difficult to determine the flooding regime naturally suited this species, and therefore its vulnerability to drought of varying duration.

Lima Stringybark (*Eucalyptus alligatrix subsp. limaensis*)

Environment Protection and Biodiversity Conservation Act (1999) status – **Endangered**

Flora and Fauna Guarantee Act (1988) status – **Critically Endangered**

Description

The Lima Stringybark is a large tree growing up to 30m tall, with rough, reddish, ‘latticing’ bark persisting to small branches. Mature leaves are narrow (lanceolate to falcate) and olive-green in colour, growing to 12 cm long.

Juvenile leaves are glaucous and ovate. Buds are green, diamond shaped and sessile and characteristically grow in groups of three. The inflorescence is 3–8 mm long, with flattened peduncles. Flowering can be sporadic, but generally occurs in April.

Habitat

The Lima Stringybark is endemic to the Goulburn Broken catchment, where it is confined to a small region within approximately 10 km radius from the Swanpool township (south of Benalla). It occurs predominantly in the 'Valley Grassy Forest' EVC on unconsolidated sediments of dark grey or brown gritty loam soils of the valleys and foothills, at about 220 m above sea level (Murphy and Downe 2006).

Priority locations in the Goulburn Broken catchment

The Lima Stringybark exists as numerous individual or small groups of trees, mainly along roadsides in the Lima and Swanpool area. Individual trees are present on private property. It is estimated that less than 1000 individuals occur in highly fragmented populations (J Mentiplay-Smith, pers. comm. 2024). The species has suffered a significant decline in the region due to extensive clearing for agriculture, ringbarking by stock and the impact of browsing fauna species (native and introduced) on plant recruitment. About 90% of the remaining population are old, mature trees, and there is very little natural regeneration occurring. It is assumed that the sub-species *limaensis* is naturally restricted, with other *alligatrix* sub-species located at Big River near Eildon and Rylstone, NSW.

A map is included in Appendix 1, Figure 18.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Lima Stringybark	Bushfire/ Drought	The small size and fragmentation of the Lima Stringybark populations exposes them to risk of extinction from stochastic processes such as bushfire and drought.	Low/medium	The species is known to regenerate well, but grazing/slashing currently prevent regeneration, increasing the vulnerability of the species to extinction.

Buxton Gum (*Eucalyptus crenulata*)

Environment Protection and Biodiversity Conservation Act (1999) status – **Endangered**

Flora and Fauna Guarantee Act (1988) status – **Endangered**

Description

The Buxton Gum also known as Silver Gum or Buxton Silver Gum, is a distinctive small tree of irregular form, growing to 12 metres in height. The bark of the mature tree is persistent and rough over most of the lower trunk, giving way to smooth bark on the upper trunk and branches. The leaves are small, to 6 cm long, ovate, blue green in colour with a hoary surface of white wax particles but ageing to glossy dark green on the upper surface.

Habitat

The Buxton Gum is endemic to south central Victoria, in the South-eastern Highlands IBRA bioregion. The species is known from only two natural populations that are about 64 km apart and separated by the Great Dividing Range. One population occurs on the periodically swampy alluvial flats of the Acheron River valley near Buxton, and the second on the floodplain of the Yarra River at Yering. These two populations occupy a total area of less than 10 ha, with fewer than 700 plants (White, Murphy and Downe 2006).

Numerous individuals have been established through planting of tubestock and the Buxton Gum is naturalised at a number of locations outside its natural range.

Priority locations in the Goulburn Broken catchment

The only natural population of Buxton Gum within the Goulburn Broken catchment is located at Buxton, where the species occupies a poorly drained hollow on the alluvial terraces adjacent to the Acheron River. Studies of aerial photography indicates that the area occupied by Buxton Gum at Buxton has not decreased significantly over the last 50 years (Adams and Simmons 2000).

A map is included in Appendix 1, Figure 19.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Buxton Gum	Bushfire	Inappropriate fire regimes may cause mortality. The small size and isolation of wild populations exposes them to risk of extinction from bushfires (White, Murphy and Downe 2006).	Medium	The species has demonstrated some capacity to regenerate after fire, although relationships between different types of fire and recruitment/ regeneration are not well understood.

Superb Parrot (*Polytelis swainsonii*)

Environment Protection and Biodiversity Conservation Act (1999) status – **Vulnerable**

Flora and Fauna Guarantee Act (1988) status – **Endangered**

Description

The Superb Parrot is a medium-sized, slender, long-tailed green parrot. Adult males are bright green above and below, with a bright yellow forehead, throat and cheeks, and a narrow red band separating a yellow throat from a green breast. Adult females are entirely green, and somewhat duller than the males.

Habitat

The Superb Parrot occurs across a large area of south-eastern Australia and is highly mobile. The core range of the Superb Parrot is west of the Great Dividing Range in New South Wales from Canberra, Goulburn and as far west as Nyngan and Swan Hill. In Victoria, the species mainly occurs between Cobram and Echuca, centred on the Barmah Forest area, particularly around Barmah, Picola, and Kotupna areas. The birds also occasionally range south to Shepparton and east to Wangaratta, Chiltern, and Corryong along the Murray River (DAWE 2021).

Superb Parrots nest in loose colonies in large, living, or dead trees with many hollow branches, typically near watercourses. Most nest sites are within 10 km of box-gum woodland and are sometimes within it. After breeding, Superb Parrots use a variety of woodlands and other habitat types, including crops, urban parks, and recreation reserves (DAWE 2021). While most River Red Gum forests are now protected, the foraging habitat across the northern plains which is critical for survival of the Superb Parrots is not (R Caldwell, pers. comm. 2024).

Priority locations in the Goulburn Broken catchment

The River Red Gum forests of the Barmah Forest Ramsar site particularly around Barmah, Picola, Kotupna, and Nathalia, are considered critical habitat and feeding sources for the Superb Parrot. Any mature riverine forests within their extended south-eastward range are also likely to be valuable for foraging and breeding. The local Superb Parrot Group has been responsible for substantial tree planting of the Superb Parrot's preferred food sources within the district and undertake annual counts of the parrot numbers.

A map is included in Appendix 1, Figure 20.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Superb Parrot	Bushfire	Increased fire frequency and intensity is a notable threat to the Superb Parrot across its range. Eucalypt flowering frequency, nectar output, and maturation of nectar-rich plant species can be reduced where fire frequency is too regular or intense, resulting in reduced foraging resources. Tree mortality can also occur and is likely in these conditions, particularly among large, hollow-bearing trees, which provide more reliable and sustained flowering	Low/medium	A single cooler fire is likely to have a negligible effect. There could be catastrophic loss of habitat from intense fires, as habitat is restricted and fragmented. A severe wildfire that destroys the canopy would remove foraging opportunities and habitat for nesting.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
		events and, critically, nesting hollows.		
	Drought/ Heatwave	Higher incidence of drought and heatwaves due to climate change may result in further reductions in the abundance of hollow-bearing trees. These events may also exacerbate current water availability stress in areas of remnant habitat, particularly for box species and Cypress Pine, and their wattle understorey, which are used as foraging sites for Superb Parrots.	Low	Impacts are based on climate change predictions.

Growling Grass Frog (*Litoria raniformis*)

Environment Protection and Biodiversity Conservation Act (1999) status – **Vulnerable**

Flora and Fauna Guarantee Act (1988) status – **Vulnerable**

Description

The Growling Grass Frog (also known as the Southern Bell Frog) is a large frog, with females growing to at least 10 cm in length. Colouration varies from dull olive to bright emerald-green, with large irregular golden-bronze blotches. The skin has numerous rounded warty projections on the back and sides.

Habitat

The Growling Grass Frog is endemic to south-eastern Australia, including South Australia, Victoria, Tasmania, NSW, and the ACT. The species occurs throughout much of Victoria except for the semi-arid north-west, far east Gippsland and higher parts of the Eastern Highlands.

The species is usually found among vegetation within or at the edges of permanent water such as slow flowing streams, swamps, lagoons, and lakes. In disturbed areas it also commonly occurs in artificial waterbodies such as farm dams, irrigation channels, irrigated rice crops and disused quarries, particularly where natural habitat is no longer available. Favoured sites frequently have a large proportion of emergent, submerged, and floating vegetation, and slow-flowing or still water (Clemman and Gillespie 2012).

Priority locations in the Goulburn Broken catchment

Monitoring of Growling Grass Frog populations north of the Great Dividing Range in Victoria is not sufficient to assess long-term population trends (Winton Wetlands Committee of Management 2023). However, there is evidence to suggest that the species continues to decline across this region. The last formal (VBA) record within the Goulburn Broken catchment was in 2009, although populations may persist in scattered localities throughout lowland regions. A significant captive breeding and reintroduction program is being carried out at the Winton Wetlands Reserve.

A map is included in Appendix 1, Figure 21.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Growling Grass Frog	Drought/ Heatwave	Droughts and heatwaves degrade and reduce habitat, decrease water quality, impact availability of food resources and increase fragmentation of populations. Decline in habitat condition or extent will result in decreased recruitment, reduced dispersal, and possible local extinctions (DEECA 2023).	Low/medium	The entire range of the Growling Grass Frog underwent a period of prolonged drought since the late 1990s, although consequences of this for the species have yet to be assessed (Clemman and Gillespie 2012).

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
	Bushfire	Bushfires can degrade water quality, and inappropriate fire regimes may damage vegetation in areas occupied by the Growling Grass Frog.	Low	Widespread disruption to habitats and ecological processes throughout the range of the species increases its vulnerability to stochastic processes such as bushfire and drought. Barriers to movement compromise its ability to recover from these events (Clemman and Gillespie 2012).
	Flooding	High rainfall especially after fire or drought can cause hypoxic blackwater events. This can affect egg and tadpole survival.	Medium/high	Growling Grass Frog populations are vulnerable and may become extinct in localised areas of flooding and hypoxic blackwater events.

Grey-headed Flying Fox (*Pteropus poliocephalus*)

Environment Protection and Biodiversity Conservation Act (1999) status – **Vulnerable**

Flora and Fauna Guarantee Act (1988) status – **Vulnerable**

Description

The Grey-headed Flying-fox is one of the largest bats in the world, with adult males generally weighing up to 1kg. Body fur is typically medium to dark grey, with many light-tipped hairs. Fur on the head is also grey but varies in shade from near black to silver. An orange or russet-coloured mantle or collar encircles the neck, which is unique to this species (DAWE 2021).

Habitat

Grey-headed Flying-foxes have a broad distribution across the coastal lowlands and slopes of eastern Australia from Queensland to South Australia. More recently, the species has become established in South Australia, the ACT and Victoria and inland areas of NSW. Patterns of occupancy and relative abundance within its distribution vary widely seasonally and temporally.

Grey-headed Flying-foxes roost in large aggregations, known as camps, in the exposed branches of trees. They display a degree of flexibility in their choice of camp vegetation. Camps occur in vegetation ranging from continuous forest to patches as small as 1 hectare.

Grey-headed Flying-foxes forage over extensive areas and have been known to fly as far as 40 km to feed, before returning to their roost the same night. They feed primarily on blossoms and fruit in canopy vegetation and supplement this diet with leaves. Major food plants include the fruit and blossom of rainforest species, especially *Ficus* spp., and blossoms of myrtaceous species such as *Eucalyptus*, *Corymbia* and *Angophora*, *melaleucas*, *banksias*, and the fruit and flowers of *Syzygium* spp.

Priority locations in the Goulburn Broken catchment

There is a large, permanent Grey-headed Flying-fox camp in Numurkah on the Broken Creek. This camp was surveyed in 2024 and 3000 bats were counted. There are also several non-permanent camps within the Goulburn Broken catchment, including at Seymour (on the Goulburn River), Nathalia, Nagambie, Tatura, and Kyabram Fauna Park (DCCEEW 2024).

A map is included in Appendix 1, Figure 22.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Grey-headed Flying Fox	Heatwave	Exposure to high temperatures results in mortality in Grey-headed Flying-foxes and is known to occur when the surrounding air temperature exceeds 40°C (DAWE 2021). They are particularly vulnerable to mortality when roost vegetation in their camps does not provide enough shade refuge.	Medium	Maintaining the vegetation integrity of camps allows individuals to naturally move within the camp to cooler areas, reducing heat-related mortality.
	Bushfire/ Drought	Fire and drought are potential causes of habitat loss. These events may also alter the timing of flowering and fruiting events and reduce the continuity of resources (DAWE 2021).	Low	Camps within the Goulburn Broken catchment are generally in close proximity to waterways and/or urban environments.

Other Threatened Woodland/Grassland Species

Description

Several national and state listed threatened flora and fauna species rely on woodland and grassland habitats within the Goulburn Broken catchment. Due to their common habitat requirements, the susceptibility of these species to emergency scenarios, and preparedness/response actions are described together.

Management actions to protect habitat for these species will have secondary benefits for threatened ecological communities including 'Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia', 'White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland', and 'Natural Grasslands of the Murray Valley Plains'.

Priority locations are likely to correspond with the distribution of relevant threatened communities and equivalent EVCs (refer to distribution notes below and Figures 23-24 in Appendix 1).

Common name	Scientific name	*Environment Protection and Biodiversity Conservation Act* (1999) status	*Flora and Fauna Guarantee Act 1988 status*	*Distribution notes*
Fauna				
Grey Falcon	*Falco hypoleucos*	Vulnerable	Vulnerable	Recorded at three sites in the Box Ironbark forests in the east of the catchment near Shepparton, Numurkah, south of Rushworth. One location at Heathcote-Graytown NP.
White-throated Needletail	*Hirundapus caudacutus*	Vulnerable	Vulnerable	'Non-breeding migrant'. Recorded at numerous sites in a variety of habitat types, Species breeds in Central Asia and southern Siberia.
Painted Honeyeater	*Grantiella picta*	Vulnerable	Vulnerable	Patchy distribution. Most records from the Box Ironbark forests around the Benalla-Warby Ranges-Coster and Heathcote-Graytown NP region.
Striped Legless Lizard	*Delma impar*	Vulnerable	Endangered	Species is restricted to temperate grasslands and grassy woodlands. Patchy distribution around Yea, Alexandra, and Benalla.
Golden Sun Moth	*Synemon plana*	Vulnerable	Vulnerable	Scattered locations across various habitat types featuring grasslands. Numerous records from Mt Piper at Broadford.
Hooded Robin	*Melanodryas cucullata*	Endangered	Vulnerable	Population records concentrated around the Warby Ovens NP, Violet Town, Heathcote-Graytown NP

Common name	Scientific name	*Environment Protection and Biodiversity Conservation Act* (1999) status	*Flora and Fauna Guarantee Act 1988* status	*Distribution notes*
				regions. Species has declined over 50% over the last 10 years.
Southern Whiteface	*Aphelocephala leucopsis*	Vulnerable	Not listed	Recorded across the catchment, particularly north of the Hume Freeway where the appropriate habitat is present.
Diamond Firetail	*Stagonopleura guttata*	Vulnerable	Vulnerable	The species is concentrated around the Warby Ranges, Heathcote-Graytown NP, Reef Hills State Park, and known breeding sites in the Euroa district. The species is assumed to be present where quality Box-Ironbark and grassy woodland habitat is present.
Brown Treecreeper (southeastern)	*Climacteris picumnus victoriae*	Vulnerable	Not listed	Population density is greatly reduced cross the catchment; especially in fragmented remnant vegetation less than 300 ha. NatureKit indicates records are present generally north of the Hume Freeway.
Blue-winged Parrot	*Neophema chrysostoma*	Vulnerable	Not listed	Few records of the Blue-winged Parrot in the catchment (NatureKit), with most entries historical. Species decline is assumed.
Flora				
Bald-tip Beard-orchid	*Calochilus richiae*	Endangered	Critically endangered	Three records near Whroo Nature Conservation Reserve. Limited past species distribution.
Small Purple Pea	*Swansona recta*	Endangered	Critically endangered	Severely restricted across the catchment. Scattered locations include along the Honeysuckle Creek northwest of Violet Town, along the Baddaginnie Creek adjacent to the Strathbogie SF, west of Glenrowan and south of the Arcadia Streamside Reserve, Murchison East.
Turnip Copperburr	*Sclerolaena napiformis*	Endangered	Critically endangered	Isolated populations south of the Lower Goulburn River, north of Tongala. Ex-situ population at Australian Botanic Gardens Shepparton.
Purple Eyebright	*Euphrasia collina subsp. muelleri*	Endangered	Endangered	Species is severely restricted. Populations recorded at Big River State Forest and Upper Goulburn State Forest.
Matted Flax-lily	*Dianella amoena*	Endangered	Critically endangered	Species is severely restricted. One population recorded at the Broken River near Mansfield. Two populations recorded at Yea.
Clover Glycine	*Glycine latrobeana*	Vulnerable	Vulnerable	Not widely represented in the catchment. Recorded in Box Ironbark and Grassy Woodlands in Heathcote-Graytown NP, Puckapunyal Commonwealth Area, and Benalla's Reef Hills SP.
Crimson Spider-orchid	*Caladenia concolor*	Vulnerable	Endangered	Recorded near Kilmore, Seymour, and Violet Town.
Euroa Guinea-flower	*Hibbertia humifusa subsp. erigens*	Vulnerable	Critically Endangered	Localised to the Euroa region, with scattered examples near Swanpool, Seven Creeks Baddaginnie, Tooborac, and Seven Creeks regions.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Threatened woodland/grassland flora and fauna	Bushfire	Flowering frequency, nectar output, and maturation of nectar-rich plant species can be reduced where fire frequency is too regular or intense, resulting in reduced foraging resources for woodland fauna. Tree mortality can also occur and is likely in these conditions, particularly among large, hollow-bearing trees, which provide habitat and more reliable and sustained flowering events.	Low/medium	There could be catastrophic loss of habitat from intense fires, as habitat is restricted and fragmented. A severe wildfire that destroys the canopy would remove habitat and foraging opportunities. A single cooler fire is likely to have a negligible effect. Intentional application of appropriate fire techniques has the potential to enhance habitat and support cultural practices.
		Many constituent plants in woodland communities recover quickly from fire by re-sprouting, and appropriate fire regimes can facilitate recruitment and increase ground layer diversity. However, too-frequent fire could threaten recruitment in slow to moderate-growing eucalypts.	Low/medium	Woodland flora species have capacity to recover vegetatively from fire. However inappropriate fire (too intense, too frequent, or mistimed) could be detrimental.
		Fire is necessary for the maintenance of some grasslands. Without fire or another disturbance dense grass can smother wildflowers, and result in a loss of habitat for some fauna species. However inappropriate fire (too intense, too frequent, too broad, or mistimed) could be detrimental to some species, and could be particularly detrimental for some grassland fauna.	Low	Grassland flora and are generally adapted and respond well to fire. However, knowledge gaps on relationships with fire persist at the species level, particularly for fauna. Further research is required.
	Drought/ Heatwave	Foraging resources are scarce during drought, increasing competition for limited resources and potentially causing some mobile species to forage in urban areas where threats of predation are collision are higher.	Low/medium	Many species are highly mobile and capable of moving to alternative habitats that can support them during times of drought. Susceptibility is greater if drought is widespread.
		Long-term reduced rainfall in winter and spring from climate change may cause stress,	Low/medium	Decline is expected to result from long-term climate

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
		mortality, and ultimately population decline for some plant species. These impacts may also be exacerbated by further fragmentation and isolation of remnants.		change rather than single drought events.
	Flood	Woodland or grassland flora species may be subjected to increased competition from weeds that are spread by riverine flooding.	Medium	These communities occur in floodplain areas in the catchment. Spread of weeds has been observed after previous flood events.

Other Threatened Wetland/Floodplain Species

Description

Several national and state listed threatened flora and fauna species rely on wetland and floodplain habitats within the Goulburn Broken catchment. Due to their common habitat requirements, the susceptibility of these species to emergency scenarios, and preparedness/response actions are described together. Management actions to protect habitat for these species will have secondary benefits for threatened ecological communities including 'Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains'.

The catchment is home to many significant wetlands including the Ramsar-listed Barmah Forest, Doctors Swamp, Moodie Swamp, Loch Garry, Gaynor Swamp, and the Winton Wetlands - the site of one of the world's most significant wetland renewal projects. There are more than 2,000 wetlands across the catchment, including large permanent lakes, ephemeral wetlands, billabongs, spring soaks, alpine bogs, and shallow depressions. Most natural wetlands are ephemeral, small (less than 10 hectares), and occur on private land.

The catchment's wetlands support a range of threatened and culturally significant animals and plants, including brolga, Sloane's froglet, broad-shelled turtle and river swamp wallaby-grass. Significant wetlands sites for Yorta Yorta Peoples include Barmah, Kanyapella Basin, and wetlands along the Lower Goulburn River. The mid and upper-Goulburn River and wetlands including Horseshoe Lagoon and Reedy Lake are important to the Taungurung People.

Priority locations include all wetlands within the catchment, particularly the Barmah Forest Ramsar site, as well as locations of associated threatened communities and equivalent EVCs (refer to distribution notes below and Figure 25 in Appendix 1).

Common name	Scientific name	***Environment Protection and Biodiversity Conservation Act* (1999) status**	***Flora and Fauna Guarantee Act 1988 status***	***Distribution notes***
Fauna				
Australian Painted-snipe	*Rostratula australis*	Endangered	Critically Endangered	Recorded at Gaynor Swamp.
Sloanes Froglet	*Crinia sloanei*	Endangered	Endangered	Recorded at Moodie Swamp and Doctors Swamp and Barmah Forest.
Curlew Sandpiper	*Calidris ferruginea*	Critically Endangered	Critically Endangered	Records at Mansfield Swamp, Lake Cooper, Greens Lake, and Barmah Forest.
Flora				
Mueller Daisy	*Brachyscome muelleroides*	Vulnerable	Endangered	Recorded at Barmah Forest
Ridged Water-milfoil	*Myriophyllum porcatum*	Vulnerable	Critically Endangered	Largest known population in Victoria recorded at Kinnairds Wetland. Populations also recorded at Moodie Swamp and Kanyapella Basin.

Common name	Scientific name	*Environment Protection and Biodiversity Conservation Act* (1999) status	*Flora and Fauna Guarantee Act 1988 status*	*Distribution notes*
Slender Darling-pea	*Swainsona murrayana*	Vulnerable	Endangered	Recorded at Mansfield and Wallenjoe Swamp
Red Swainson-pea	*Swainsona plagiotropis*	Vulnerable	Endangered	Not recorded in catchment since 1991 on private property near Corop.
River Swamp Wallaby-grass	*Amphibromus fluitans*	Vulnerable	Not listed	Recorded at Black Swamp, Barmah Forest, Reedy Swamp, Kanyapella Basin and Loch Garry, Winton Wetlands, Horseshoe Lagoon, private remnants/wetlands, and a number of wetlands along the lower Goulburn River floodplain.
Winged Peppercress	*Lepidium monoplocoides*	Endangered	Endangered	Recorded at Barmah Forest.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Threatened wetland/floodplain flora and fauna	Drought	Droughts degrade and reduce wetland habitat, decrease water quality, impact availability of food resources and increase fragmentation of populations. Decline in habitat condition or extent may result in decreased recruitment, reduced dispersal, and possible local extinctions.	Low/medium	Environmental watering can support species at key sites including the Barmah Forest. Consequences of prolonged drought for some species are untested.
		Timing, depth, and duration of inundation are important in the growth of many wetland plants. Recruitment from seed may depend upon suitable conditions, which may be impacted by drought or altered hydrology.	Low	Knowledge gaps persist for some species regarding natural flooding regimes, and their vulnerability to drought of varying duration.
	Bushfire	Intense and frequent bushfires in wetlands can alter the density and cover of vegetation that forms habitat for wetland fauna, potentially increasing risk of predation or resulting in reduced breeding success.	Low/medium	Individual wetlands may require different fire regimes depending on vegetation type and location. Appropriate patch burning techniques have potential to enhance habitat, encourage the regeneration of native plant species and support cultural practices.
		Fire may play and important role in the life cycles of some wetland plants. However, fires that are too frequent, too intense, or that occur at a vulnerable growth stage may affect long-term survival.	Low/medium	Knowledge gaps persist for some species regarding their response to fires of varying intensity/frequency.

Other Threatened Montane Forest/Alpine Species

Description

Several national and state listed threatened flora and fauna species rely on montane forest or alpine habitats within the Goulburn Broken catchment. Due to their overlapping distribution within the catchment, the susceptibility of these species to emergency scenarios and preparedness/response actions are described together.

Forest systems in the Central Highlands in the southern part of the Goulburn Broken catchment are comprised of a range of tenures including private land, State Forests, Alpine Resorts, and National Parks. These areas contain a range of diverse and unique vegetation communities, including sections of state-significant Primary Rainforest (DEECA 2024). These communities and the species they support face ongoing threats from timber harvesting, fire events, climate change, and the spread of invasive plants and animals.

Taungurung Land and Waters Council have undertaken Rapid Biocultural Assessments across montane forest systems within the catchment, identifying biocultural values (e.g. Debera, Bogong Moth), assessing the biocultural health of these systems, and proposing pathways for healing Country (Hansby, et al. 2023). Included in these pathways is restoration of Taungurung cultural land management practices including cultural burning, to better manage risk of landscape-scale bushfire events in these fire-prone areas.

Priority locations include sites of cultural importance and areas of high concentration of occurrence of threatened species within montane forests and sub-alpine/alpine zones in the southern part of the catchment, extending into the western reaches of the Australian Alps. Refer to distribution notes in table below. A map is also included in Appendix 1, Figure 26.

Common name	**Scientific name**	***Environment Protection and Biodiversity Conservation Act* (1999) status**	***Flora and Fauna Guarantee Act 1988* status**	***Distribution notes***
Fauna				
Gang-gang Cockatoo	*Callocephalon fimbriatum*	Endangered	Not listed	Majority of records from south of the Hume Freeway.
Spot-tailed Quoll	*Dasyurus maculatus maculatus*	Endangered	Endangered	Scant records from the Seymour, Mansfield, Dookie, and Merton regions.
Southern Greater Glider	*Petauroides volans*	Endangered	Vulnerable	Majority of records from south of the Hume Freeway in the Strathbogie SF and Mt Samaria SP regions.
Smoky Mouse	*Pseudomys fumeus*	Endangered	Endangered	Present in the southern part of the catchment. Recorded in the Lake Eildon NP, Upper Goulburn SF and Big River SF regions. Populations are generally small and fragmented and experience local extinctions.
Mountain Skink	*Liopholis montana*	Endangered	Not listed	Recorded around the Mt Buller and Upper Goulburn SF regions in montane and sub-alpine habitat featuring granite and basalt boulders, rocky screes, and large logs.
Pilotbird	*Pycnoptilus floccosus*	Vulnerable	Not listed	Records from the Big River SF, Upper Goulburn SF, Lake Eildon NP, Mt Samaria SP, Rubicon SF, Lake Mountain, Holland Creek/Ryans Creek and Blue Range regions south of Benalla.
Yellow-bellied Glider	*Petaurus australis*	Vulnerable	Not listed	Records from around the Big River, Upper Goulburn SF, Lake Eildon NP, Mt Torbreck NFR and Scenic Reserve, Rubicon SF, Howqua Hills Historic Area, and Mt Timbertop regions.
Broad-toothed Rat	*Mastacomys fuscus mordicus*	Vulnerable	Vulnerable	Distribution declining, mostly restricted to suitable habitat within alpine/sub-alpine zones, particularly Lake Mountain, Mount Buller, and Mount Stirling Alpine Resorts.

Asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Threatened forest fauna	Bushfire	Increased fire frequency and intensity is a notable threat across mountain forest systems within the catchment. Eucalypt flowering frequency, nectar output, and maturation of nectar-rich plant species can be reduced where fire frequency is too regular or intense, resulting in reduced foraging resources. Tree mortality can also occur and is likely in these conditions, particularly among large, hollow-bearing trees, which provide important habitat for many species.	Medium/high	There could be catastrophic loss of habitat from intense fires, as habitat is restricted and fragmented. A severe wildfire that destroys the canopy would remove foraging opportunities for less-mobile species. Application of appropriate fire techniques has the potential to mitigate risk of intense fires and support cultural practices.
	Drought/ Heatwave	Higher incidence of drought and heatwaves due to climate change may result in further reductions in the abundance of hollow-bearing trees. Habitat condition will also be reduced due to vegetation dieback during drought conditions.	Low/medium	Impacts are based on climate-change predictions.
Threatened alpine/sub-alpine fauna (Mountain Skink, Broad-toothed Rat)	Bushfire	Vegetation within the alpine zone is generally sensitive to fire and is slow to regenerate after being burnt or scorched. Loss of vegetation removes cover, food sources and movement corridors.	Medium	Increased frequency or a single high intensity fire may result significant loss of habitat, which may have severe consequences for alpine species with restricted range.
	Drought/ Heatwave	Changes in snowfall and snowmelt regimes due to climate change affect groundwater and runoff patterns, which may affect habitat condition through a loss or change in vegetation. Higher and more frequent extreme summer temperatures may also cause heat stress or disrupt breeding cycles.	Medium/high	Alpine species occur at the climatic and elevational limits of their possible range and are therefore uniquely vulnerable to the potential impacts of a changing climate. The ability of these species to adapt to climatic changes is largely unknown.

6. BIODIVERSITY ASSETS – PREPAREDNESS ACTIONS

This section outlines preparedness actions that could be undertaken for each biodiversity asset to reduce the threat of relevant emergency scenarios such as bushfires/heatwaves, drought, and floods. Tables for each biodiversity asset include:

- Suggested preparedness actions.
- Where the action should be undertaken.
- The organisation or group that could undertake or is already undertaking the action.

In cases where there is an active State or National Recovery Team for a particular species or community, actions should be undertaken in consultation with the Recovery Team.

Case studies or examples are included below where these actions have been undertaken previously in the Goulburn Broken catchment.

DEECA's procedures

The *Conservation Forests and Lands Act 1987* requires the Department of Environment, Land, Water and Planning (now Department of Energy, Environment and Climate Action) through the Code of Practice for Bushfire Management on Public Land 2012, to develop a risk-based approach to bushfire management on public land (DELWP 2020).

The Hume Bushfire Management Strategy (Safer Together) 2020

The Hume Bushfire Management Strategy 2020 informs the development of operational plans, primarily the Joint Fuel Management Program (JFMP). The JFMP is the three-year rolling statewide program of fuel management works on public and private lands carried out by Forest Fire Management Victoria (FFMVic) and Country Fire Authority (CFA) to reduce bushfire risk and to maintain the health of native plants and animals that rely on fire to survive. Works include planned burning, slashing, mowing, and clearing works, creating, and maintaining fuel breaks, and carrying out maintenance on fire infrastructure (like fire dams and lookout towers).

The Strategy also identifies actions that agencies and communities can undertake to manage bushfire risk beyond (i.e. to complement) fuel management, including issuing fire danger warnings and advice, managing fuel hazard reduction on private land, asset protection, commissioning bushfire science research, and recruiting and training firefighters. Actions that community members can take include developing and practising a bushfire plan, fully extinguishing campfires, preparing their property, and participating in community bushfire preparedness activities and events.

The Hume Bushfire Management Strategy recognises the Victorian Traditional Owner Cultural Fire Strategy (described below), which also has an important role in informing the JFMP in consultation with individual First Nations groups.

Fire Management

DEECA conducts a Biodiversity Values Assessment (values check) prior to fuel management activities including planned burns and non-burn fuel treatments and other programs and works. This is a due diligence process that ensures that DEECA complies with several pieces of legislation including the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC), Victorian *Flora and Fauna Guarantee Act 1988* (FFG) and the Victorian *Planning and Environment Act*. DEECA conducts a Biodiversity values assessment (values check) as part of operational planning to identify where works might intersect with values. DEECA are responsible for determining the most effective way to avoid or mitigate potential impacts.

Values checking is the process of identifying the most significant values based on existing legislative requirements. Consideration is given to known recorded biodiversity values, species Habitat Distribution Models and local or iconic species. Values meeting at least one of the criteria described below are considered for a risk assessment:

- All EPBC (national) and FFG listed (state) values. This includes all threatened species and communities that are Critically Endangered, Endangered and Vulnerable.
- All known records of breeding, roosting, or feeding sites.
- Fire sensitive Ecological Vegetation Classes (EVCs).
- Other taxa identified as at high fire risk based on their biology (from data sources such as Vital Attributes) and/or iconic or local species. The Flora Vital Attributes database curated by the Arthur Rylah Institute for Environmental Research identifies life history traits of plants that can be used to determine their susceptibility to fire.

All information is reviewed, and a risk-based approach is applied to avoid or mitigate potential impacts.

Mitigation measures are text based ‘prescriptions’ developed for biodiversity values that are considered in the context of planned burning. They are aimed at providing advice and information to protect or enhance recorded biodiversity values found within burns, by managing threats and impacts associated with planned burning.

Mitigations are not required for all species, only species that are sensitive to:

- Earthworks, machinery, or soil disturbance
- Direct impact from fire
- Excessive frequency or intensity
- Inappropriate season and timing
- Insufficient frequency and
- Loss of structure or vegetation cover

Threats may be direct, such as an entity being scorched, crushed, or disturbed, or indirect such as increased soil mobilisation causing sedimentation in nearby waterways and the potential for aquatic species deaths.

First Nations cultural fire practices

The cultural use of fire by First Nations is a socially and ecologically complex practice, governed by kinship, eldership, spiritual connections to Country and environmental interactions with fire. First Nations used fire as a tool for managing Country for a wide range of purposes, including protecting Country, providing habitat for wildlife and the harvesting of resources. Cultural landscapes that extend beyond and across western administrative boundaries are also considered.

Victorian Traditional Owners have strong aspirations to ensure cultural use of fire is re-introduced, adapted, and applied wherever possible to allow for healing and caring for Country.

The Victorian Traditional Owner Cultural Fire Strategy

The Victorian Traditional Owner Cultural Fire Strategy 2020 provides a set of principles and strategic priorities to facilitate greater self-determination for Traditional Owners and a framework for effective Traditional Owner-led cultural fire management in Victoria .

The six principles underpinning the strategy and framework across Victoria’s fire and land management agencies to support Traditional Owners to undertake cultural burning, for the range of cultural values entailed in caring for Country are summarised as:

- Cultural burning is right fire, right time, right way and for the right (cultural) reasons
- Burning is a cultural responsibility
- Cultural fire is living knowledge
- Monitoring, evaluation, and research support cultural objectives and enable adaptive learning.
- Country is managed holistically
- Cultural Fire is healing

The vision in the strategy is that generations of Victorian First Nations people will grow-up observing their Elders leading the use of the right fire for Country. They will be trusted to know the special reasons why fire is used and how it brings health to the land and people. Their children and grandchildren will see culturally valuable plants and animals return to Country and know their stories. Victorian First Nations people wish to emphasise the inter-generational nature of this change, the fact that cultural fire is really about people and that trust must be given, placing authority in people’s hands. The First Peoples of Victoria further stress that using fire to realise culturally meaningful objectives will also achieve risk reduction as a complementary outcome.

Fire as a tool for managing Country has been mentioned via the application of cultural burning within sites occupied by relevant assets included in this Plan.

Preparedness actions requiring investment

Common actions for all threatened species and ecological communities that require investment and where there are current gaps include:

- Surveys in suitable habitat to:
    - Confirm persistence and characteristics of threatened species populations at previously recorded locations, especially where records are old.
    - Identify new locations requiring protection.
- Surveys to improve mapping, known locations and understanding of the condition of threatened ecological communities.
- Ensure species location data and ecological information is available and considered in fire-management activities, including regularly updating information in web-based information and mapping platforms used for emergency management.

Threatened Ecological Communities (preparedness)

Case Study 1: Linking Landscapes Grey Box Grassy Woodland RLP Project:

The Linking Landscapes Regional Land Partnerships project (2018 – 2023) delivered a broad program of works to restore and improve the condition of Grey-box Grassy Woodland and Derived Native Grassland habitat within the Goulburn Broken catchment. The project included revegetation of 540 hectares (planting and direct seeding) of Grey-box Grassy Woodland on private and public land, grazing control (fencing), and over 5,000 hectares of pest plant and animal control. The project was funded by the Australian Government's National Landcare Program.

Asset	Emergency scenario	Actions	Where	Who	Is action currently underway?
Seasonal herbaceous wetlands of the temperate lowland plains	Drought	Establish or support existing long term monitoring programs. Monitoring should include effects of climate change.	Known sites	DEECA, land managers, CMA	Partially
		Determine optimal management that supports and enhances existing hydrological regimes.	Priority or high-quality sites	DEECA, CMA	Partially
		Deliver water for the environment or other water where possible.	Where delivery points are available	CMA, VEWH, land managers	Partially
		Manage weeds and pests.	Known sites	Relevant land managers	Partially
		Establish buffer zones.	Priority or high-quality sites	CMA, land managers	Partially
		Extension and education on identification, values, and management.	Known sites	Private land holders, local government	Partially
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Bushfire	Implement ecological burning regimes based on recovery plan recommendations.	Known locations	DEECA (Forest Management Victoria), CFA, land managers	Yes (public land)
		Work with First Nations to identify pathways for acknowledgement and implementation of cultural fire practices.	Culturally significant sites / ecologically significant sites	First Nations, DEECA and land managers (e.g. PV)	Partially (DEECA Cultural Burning Officer)
	All	Promote regeneration, control grazing, control pest plants and animals.	Known locations	DEECA, CFA, land managers, TFN, CMA (with funding)	Partially
Natural Grasslands of the Murray Valley Plains	Drought	Monitor sites for species composition.	Known locations	Land managers, TFN, CMA	Partially (monitoring)
	Bushfire	Implement ecological burning regimes based on recovery plan recommendations.	Known locations	DEECA (Forest Management Victoria), CFA, land managers	Yes (public land)
		Work with First Nations to identify pathways for acknowledgement and implementation of cultural fire practices.	Culturally significant sites / ecologically significant sites	First Nations and land managers (e.g. PV)	Partially (DEECA Cultural Burning Officer)
Alpine Sphagnum	Bushfire	Ensure that peatland mapping is updated in	Known locations	FFMVic, DEECA, PV,	Ongoing

Bogs and Associated Fens (and associated fauna)		statewide databases used by Fire Incident Management Teams.		land managers, Alpine Resorts	
		Maintain accurate fire history via mapping of extent, frequency, severity (or intensity) and regeneration.	Previously impacted sites	FFMVic, DEECA, PV, land managers, Alpine Resorts	Partially
		Incorporate appropriate management guidelines for fire suppression in the ecological community as part of fire management plans.	Known locations	FFMVic, DEECA, PV, land managers, Alpine Resorts	Guidelines have been developed.
		Improve knowledge about the importance and locations of the ecological community for field staff and fire management operators.	Known locations	EM agencies, FFMVic, CFA, Incident control staff Field staff	Information has been developed
		Conduct fuel reduction burns, remove woody shrubs, and promote grassland establishment in areas surrounding Alpine Bogs to reduce risk of fires spreading into these systems.	Select or prioritised sites	PV, DEECA, land managers, Alpine Resorts, CMA (with funding)	Partially, e.g. willow control on Mt Stirling
	Drought	Establish long-term monitoring.	Known locations	DEECA, PV, land Managers, Alpine Resorts, CMA	Partially
		Maximise the structural and functional integrity and resilience of Alpine Bogs to the effects of drought and climate change by undertaking recommended actions to address other threats such as weeds (e.g. willows) and pests (e.g. deer).	Select or prioritised sites	DEECA, PV, land Managers, Alpine Resorts, CMA, First Nations	Partially - currently not adequately funded
		Research to better understand the impacts of future climate change and bushfire on Alpine Bogs and explore the best ways to minimise risk and build natural resilience.		Research institutions, CMA, PV, First Nations	Partially - currently not adequately funded
	All	For associated fauna: establish or expand on existing monitoring and research programs, including further surveys to understand limits of extant populations.		CMA, DEECA Natural Environment Program	Partially
		For associated fauna: establish or expand on existing captive breeding programs or		DEECA, ARI, CMA, Recovery teams, other	Partially

		translocation/reintroduction programs, where relevant and appropriate.		partners (e.g. Zoos Victoria)	
Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Bushfire	Implement ecological burning regimes based on recovery plan recommendations.	Known locations	DEECA, FFMVic, CFA, land managers, TFN, CMA	Yes (public land), via Landscape Legacies Grey Box RLP and NHT Project/s.
		Work with First Nations to identify pathways for acknowledgement and implementation of cultural fire practices.	Culturally significant sites / ecologically significant sites	First Nations and land managers (e.g. PV)	Partially (DEECA Cultural Burning Officer)
	All	Promote regeneration, control grazing, control pest plants and animals.	Known locations	DEECA, CFA, land managers, TFN, CMA (NHT funding)	Partially, via Landscape Legacies Grey Box RLP and NHT Project/s.
Buloke woodlands of the Riverina and Murray-Darling depression bioregions	Bushfire	Establish and maintain firebreaks where appropriate.	Susceptible sites	Land manager e.g. DEECA, FFMVIC, CFA	Partially on public land
		Trial ecological/fuel management burns.	Selected public land sites	DEECA, PV, FFMVIC, CFA	Partially on public land
		Establish adequate fuel-management programs.	Public land locations	DEECA, PV, FFMVIC, CFA	Partially on public land
	All	Establish long-term monitoring.	Known locations	DEECA, PV, CMA, land managers	Partially on public land
		Promote regeneration, control grazing, control pest plants and animals.	Known locations	Land Managers, CMA	Partially at funded locations
		Ensure awareness and protection of cultural sites associated with adjacent sandhill areas.	Known locations	DEECA, First Nations, Land manager, CMA, TFN	Partially at funded locations

Barmah Forest Ramsar Site (preparedness)

Case Study 2: 'Barmah Country' RLP/NHT Project Pest Plant and Animal Control:

Pest plant and animal control and monitoring is ongoing within the Barmah National Park in accordance with the Barmah Ramsar Site Pest Plant and Animal Strategy 2013. Significant annual fox control, feral pig control, priority weed control, and associated monitoring occurs through the GB CMA's Barmah Country Natural Heritage Trust Project 2023-28, a continuation of the Barmah Country Regional Land Partnerships (RLP) Project 2019-2023), funded by the Australian Government through the National Landcare Program.

Barmah Forest Ramsar Site				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action underway?**
Bushfire	Mosaic burning to manage vegetation, enhance habitat, encourage regeneration, and support cultural practices. Individual wetlands may require different fire regimes depending on vegetation type and location.	Strategic locations	DEECA, PV, TOs (Joint Management Plan)	Partially – as part of fuel-management program
	Establish fire breaks, avoiding damage to biodiversity assets.	Strategic locations	PV	

	Work with First Nations to identify pathways for acknowledgement and implementation of cultural fire practices.	Culturally/ ecologically significant sites	First Nations and land managers (e.g. PV)	Partially (DEECA Cultural Burning Officer)
Drought (long term)	Maintain inflows to wetlands in accordance with Seasonal Watering Plans.	Strategic locations	PV	Yes, but more effort required in droughts.
	Protect vegetation through pest plant and animal control.	Priority locations	PV, DEECA, CMA (with funding)	Yes (funded programs being implemented)
All	Establish or expand on existing monitoring and research programs, e.g.: • Further surveys to determine distribution of priority species/communities. • Address knowledge gaps regarding natural flooding regimes, and the vulnerability of the site to drought of varying duration. • Address knowledge gaps regarding response to fires of varying intensity/frequency.		Research institutions, DEECA, ARI, CMA, First Nations	Partially

Threatened Species (preparedness)

Case Study 3: Swift Parrot Pantry Project:

The Swift Parrot Pantry project (2022-2023) increased the extent of food and habitat trees, increased linkages, and improved the condition of existing native vegetation. Existing remnant patches were modified and improved by planting understorey species. A 60ha site was revegetated (including a 7ha Seed Production Area), and 17ha of understorey planting was implemented near remnant Swift Parrot feed trees at the Reedy Lake Nagambie Wildlife Reserve. The project was funded by the Australian Government's Environmental Restoration Fund.

Case Study 4: Winton Wetlands Growling Grass Frog Reintroduction Program:

Winton Wetlands Committee of Management began development of a captive breeding and reintroduction program for Growling Grass Frogs in 2021 at Winton Wetlands near Benalla, in the Goulburn Broken catchment. This has so far involved working through an extensive approval and permits process, leading to the creation of a custom-built quarantine laboratory and captive breeding habitat pods at Winton Wetlands. They have also established a Practitioners' Network including scientists, managers, and community experts to help advise, and share information about the species. Initial preparatory stages were funded by Wettenhall Environment Trust and the Ross Trust (philanthropic trusts), along with the GB CMA, the MDBA, and DEECA. There has been in-kind support from several sources, including Coliban Water and the Yorta Yorta community. Funding for subsequent stages is being sought through philanthropic sources, community fund-raising and Federal Government grants.

Case Study 5: Spotted Tree Frog Project:

The Spotted Tree Frog Project is a collaboration between Zoos Victoria, DEECA, the University of Melbourne, and the NESP Threatened Species Recovery Hub. The project involves maintaining a population in captivity, monitoring existing wild populations, and re-introducing frogs into the wild. The project is supported by the Australian Government's National Environmental Science Program through the Threatened Species Recovery Hub and funding from the Australian Government's Bushfire Recovery Program for Wildlife and their Habitats.

Threatened fish species				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action underway?**
Bushfire	Develop or expand on existing plans or processes to address water quality impacts following bushfire events e.g. Water quality traffic lights for native fish: Decision support tool for managing poor water quality events (Cornell, Stoios and Lyon 2023).		DEECA, ARI, CMA	Yes
	Vegetation management in priority, high-risk areas.	Priority locations	DEECA, CMA,	Partially

			land managers	
Flood	Conduct or expand on research into avoidance or minimisation of blackwater events during both natural and artificial flooding events.		CMA, ARI	Partially
	Develop or expand on existing blackwater and species protection management plans to protect species from blackwater events.		CMA, ARI	Partially
Drought /Heatwave	Appropriate application of environmental water to improve habitat condition (e.g. to increase bank vegetation), or to encourage breeding, spawning, movement, and recruitment.	Known locations	CMA, VEWH	Partially
	Improve condition of in-stream and off-stream habitat, for example by promoting growth of native aquatic plants and provide shading.	Known locations	CMA, land managers	Partially
	Restoration of on-farm dams with vegetation as drought refugia.		CMA, land managers	Partially
All	Restore and improve habitat condition: vegetation stabilising riverbanks, re-snagging areas for fish protection, food resources and breeding habitat.	Known locations	CMA, land managers	Yes
	Restore and improve habitat condition for Macquarie perch by protecting and improving riparian and instream vegetation, re-snagging areas for fish protection, food resources and breeding habitat.	Priority locations	CMA, land managers	Yes, on priority waterways
	Control invasive species to reduce pressure on threatened native fish.		DEECA, ARI, CMA	Partially, e.g. Trout barriers, Redfin and Carp removal
	Control invasive species such as redfin and carp to protect Macquarie perch.	Priority locations	ARI	Yes
	Install and maintain trout barriers to protect small-bodied fish in upland streams	Priority locations	DEECA, CMA	Yes
	Establish or expand on long-term monitoring of populations to provide a historical context.		ARI	Yes
	Undertake or expand on research to improve data on vulnerability of species to water quality changes.		ARI	Partially
	Conduct research on captive breeding techniques for relevant species e.g. Macquarie Perch.		ARI, VFA	Yes
	Establish or expand on existing captive breeding programs and facilities, e.g. Snobs Creek, Arcadia.		VFA	Yes
	Identify potential translocation sites to establish new populations, or sites requiring bolstering with additional individuals		DEECA, ARI, CMA	Partially
	Undertake genetic analysis of Macquarie perch and translocate between populations to improve genetic diversity	Priority locations	ARI	Yes
	Prepare translocation plans for relevant species, considering national and State policies and guidelines for translocation.		ARI	Partially
	Manage threats at potential translocation sites.	Translocation sites	CMA, land managers	Partially

Swift Parrot				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action underway?**
Bushfire	Controlled burns (mosaic burns) to manage vegetation, in consultation with Swift Parrot experts.	Known habitat (public land)	DEECA, FFMVic	Yes
	Values assessment and asset management advice to mitigate impacts of planned burn operations. Consider timing and frequency to minimise impact on flowering and nectar production.	Known habitat (public land)	DEECA Natural Environment Program	Yes
All	Build resilience by improving habitat condition and connectivity on public and private land.	Known habitat (public and private land)	Land manager, with support from Trust for Nature, DEECA, CMA (with funding)	Yes
	Expand on existing monitoring and research programs, including further surveys to understand limits of extant populations.		CMA, DEECA	Partially. Bi-annual Swift Parrot Search undertaken at fixed sites, in addition to traditional 'roaming' searches.

Regent Honeyeater				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action underway?**
Bushfire	Controlled burns (mosaic burns) to manage vegetation, in consultation with Swift Parrot experts.	Known habitat (public land)	DEECA, FFMVic	Yes
	Values assessment and asset management advice to mitigate impacts of planned burn operations. Consider timing and frequency to minimise impact on flowering and nectar production.	Known habitat (public land)	DEECA Natural Environment Program	Yes
All	Build resilience by improving habitat condition and connectivity on public and private land.	Known habitat (public and private land)	Land manager, with support from Trust for Nature, DEECA, CMA (with funding through the Landscape Legacies Grey Box NHT project), Regent Honeyeater Project Inc., Winton Wetlands Inc.	Yes. Revegetation occurring at Winton Wetlands by the Regent Honeyeater Project, funded by the GB CMA Landscape Legacies Grey Box NHT Project.
	Expand on existing monitoring and research programs, including further surveys to understand limits of extant populations.		CMA, DEECA Natural Environment Program, Regent Honeyeater Project Inc.	Partially. Regent Honeyeater surveys are also conducted during the bi-annual Swift Parrot searches.

Leadbeater's Possum				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action current underway?**
Bushfire	Vegetation management (including in adjacent drier forest types) to protect identified colonies and high-quality habitat from bushfire, where appropriate and in consultation with species experts.	Priority locations	DEECA, FFMVic, land managers (e.g. PV)	Yes
	Values assessment and asset management advice to mitigate impacts of planned burn operations, including impacts of strategic fuel breaks on connectivity.	Known habitat (public land)	DEECA Natural Environment Program	Yes
	Identify known colonies and high-quality habitat as critical assets in relevant in geospatial databases to inform fire operations and risk landscape planning.	Priority locations	DEECA Natural Environment Program, land managers (e.g. PV)	Yes
	Develop (or refine existing) approved fire recovery protocols that can be enacted without delay following fire or other disturbance events that affect known colonies.	Priority locations	DEECA, FFMVic, land managers (e.g. PV), Zoos Victoria	Yes
	Work with First Nations to identify pathways for acknowledgement and implementation of cultural fire practices at landscape scale.	Culturally significant sites / ecologically significant sites	First Nations and land managers (e.g. PV)	Partially (DEECA Cultural Burning Officer)
All	Improve understanding of habitat survival to identify landscape features and habitats that are resilient to natural disturbance processes.	Known habitat	DEECA, Universities	Partially
	Investigate (or expand existing) approaches to support existing populations by increasing availability of den sites, for example by providing artificial nestboxes at key locations or by accelerating hollow development.	Priority locations	DEECA, land managers (e.g. PV), Zoos Victoria	Partially
	Establish (or expand on existing) monitoring and research programs, including research on dispersal and recolonisation capacities, population demographics, and habitat requirements, e.g. determining habitat critical to survival in sub-alpine woodland.		CMA, DEECA Natural Environment Program	Partially
	Establish (or expand on existing) captive breeding programs, translocation feasibility studies and/or development of translocation guidelines.		DEECA, ARI, CMA, Recovery team, other partners (e.g. Zoos Victoria)	Partially

Spotted Tree Frog				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action underway?**
Bushfire	Develop or expand on fire management strategies for each catchment, including provision for treatment of bushfire such that minimal disturbance to Spotted Tree Frog habitat is maintained. Fuel reduction burning should be excluded from all catchments upstream of Spotted Tree Frog habitat where possible (Gillespie and Robertson 1998).	Known locations	DEECA, CMA, land managers	Unknown
Drought/ Heatwave	Restore and improve condition of streamside habitat.	Known locations	DEECA, CMA, land managers	Partially
All	Establish or expand on existing monitoring and research programs including: - Long term population monitoring to understand stability and impact of interventions - Intensive population monitoring to understand demographics - Further surveys to understand limits of extant populations - Genetics studies - Population viability analyses - Fish exclusion studies/trials		DEECA, ARI	Partially
	Expand on existing captive breeding program (Spotted Tree Frog Recovery Program).		Spotted Tree Frog Recovery Program	Yes
	Expand on existing translocation/reintroduction programs (Spotted Tree Frog Recovery Program).		Spotted Tree Frog Recovery Program	Yes

Round-leaf Pomaderris				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action underway?**
Bushfire	Vegetation management in priority, high-risk areas, where appropriate and in consultation with species experts. Fire management should promote an ecologically appropriate fire regime for the Round-leaf Pomaderris.	Priority locations	DEECA, FFMVic, land managers	Yes
	Values assessment and asset management advice to mitigate impacts of planned burn operations.	Known habitat (public land)	DEECA Natural Environment Program	Yes
	Mapping of known occurrences in high-risk areas for inclusion in geospatial databases used in fire response, operations, and risk landscape planning.	Priority locations	DEECA Natural Environment Program	Yes
	Work with First Nations to identify pathways for acknowledgement and implementation of cultural fire practices at landscape scale.	Culturally significant sites / ecologically significant sites	First Nations and land managers (e.g. PV)	Partially (DEECA Cultural Burning Officer)
All	Investigate options for linking, enhancing, or establishing additional populations.	Known locations (public and private land)	DEECA, CMA (with funding)	Partially

	Establish or expand on existing monitoring and research programs, including further surveys to understand limits of extant populations, research on suitable fire regimes, genetic risks, and causes of population decline and low recruitment.		CMA, DEECA Natural Environment Program	Partially
	Explore opportunities to collect seed and establish ex-situ populations or reintroduce to sites, where relevant and appropriate.		DEECA, CMA, other partners (e.g. Goulburn Broken Indigenous Seedbank, Botanic Garden)	Partially

Spiny Rice-flower				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action underway?**
Bushfire	Research to address knowledge gaps regarding species response to fires of varying intensity/frequency, including ecological burning trials in consultation with species experts.		DEECA, First Nations, CMA, Recovery team	Partially
	Explore opportunities to collect seed and establish ex-situ populations or reintroduce to sites, where relevant and appropriate.		DEECA, CMA, Recovery team, other partners (e.g. Goulburn Broken Indigenous Seedbank, Royal Botanic Gardens)	Partially
	Determine (or refine) techniques for successful translocation, including selection criteria for translocation sites.		DEECA, CMA, Recovery team, other partners	Partially

Australasian Bittern				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action underway?**
Drought	Water managers are aware of the species' requirements and have consideration for these requirements in water management e.g. Seasonal Watering Plans.	Barmah Forest and other managed waterways known to support Australasian Bittern.	CMA, VEWH, CEWH	Partially.
Bushfire	Monitor to determine locations frequented by Bittern and integrate data into existing bushfire response tools/processes.	Locations with previously	Research institutions, CMA,	Yes, part of The Living

Australasian Bittern				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action underway?**
		recorded sightings, or suitable habitat.	DEECA, land managers	Murray program
	Planned burning to protect habitat wetlands and waterways, considering the following: - Exclude burning from riparian areas and vegetation adjacent to wetlands (10m buffer) during spring and summer. - Establish 10 m buffer around wetlands and waterways and prevent burns and works from impacting on these. Where burning of riparian vegetation is required, retain 60% of the reedy habitat.	Wetlands/ waterways known to support Australasian Bittern.	DEECA, land managers	Partially
	Develop and implement fire-management guidelines for the maintenance of Australasian Bittern habitat.		Research institutions, DEECA, Recovery Team	Unknown

Mountain Pygmy-possum				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action underway?**
Bushfire	Protection of habitat through vegetation management in priority, high-risk areas, in consultation with species experts. Actions could include seasonal fuel reduction burning, removal of flammable shrubs that deliver fire into habitats, and establishment of fire breaks surrounding habitats.	Areas surrounding known habitat	DEECA, FFMVic, land managers, First Nations	Partially - Alpine Resorts have mapped key assets. Main areas within the Alpine National Park are mapped, but further updates are required.
All	Expand on existing monitoring and research to understand population dynamics, emerging threats, and conservation requirements, including further surveys to discover new populations.	All known populations and boulderfield sites that represent potential habitat	DEECA, land managers (e.g. Alpine Resorts, PV), First Nations, CMA, other partners (e.g. Zoos Victoria, Ecology Links)	Partially - monitoring underway in key populations, but not all. Surveys of new locations via infrared cameras underway by Zoos Victoria in partnership with PV.
	Research to investigate habitat use before and after emergencies.	All known habitat	DEECA, land managers (e.g. Alpine Resorts, PV), First Nations,	Partially – Zoos Victoria

			CMA, other partners (e.g. Zoos Victoria, Ecology Links)	

Stiff Groundsel				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action underway?**
Bushfire	Research to address knowledge gaps regarding species response to fires of varying intensity/frequency, including ecological burning trials in consultation with species experts.		DEECA, First Nations, CMA	No
Drought	Research to address knowledge gaps regarding ecologically appropriate hydrological regimes.		DEECA, CMA	No
All	Explore opportunities to collect seed and establish ex-situ populations or reintroduce to sites, where relevant and appropriate.		DEECA, CMA, other partners (e.g. Goulburn Broken Indigenous Seedbank, Royal Botanic Gardens)	Partially – Royal Botanic Gardens Victoria are leading a project on this species with Wetland Revival Trust
	Determine (or refine) techniques for successful translocation, including selection criteria for translocation sites.		DEECA, CMA, other partners	Partially

Lima Stringybark				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action underway?**
Bushfire	Education and asset management advice to mitigate impacts of planned burning or other fuel management on private property and/or roadsides.	Known occurrences	Benalla Rural City Council, CMA, land holders, CFA	Partially
	Mapping of known occurrences for inclusion in geospatial databases used in fire response, operations, and risk landscape planning.	Known occurrences	DEECA Natural Environment Program	Yes
All	Investigate options for linking, enhancing, or establishing additional populations.	Known locations (private land, roadsides)	DEECA, CMA (with funding)	Partially
	Establish or expand on existing monitoring and research programs, including research on emerging threats and conservation requirements.	Known locations (private land, roadsides)	CMA, DEECA Natural Environment Program	Unknown
	Explore opportunities to collect seed and establish ex-situ populations or reintroduce to sites, where relevant and appropriate.	Known locations (private land, roadsides)	DEECA, CMA, other partners (e.g. Goulburn Broken Indigenous	Unknown

			Seedbank, Botanic Garden)	
	Support community participation and improve awareness of the Lima Stringybark and conservation of its habitat, e.g. through installation of large paddock tree guards to protect regenerating trees.		DEECA, Swanpool Landcare, CMA (with funding)	Partially - Swanpool Landcare have previously been active in raising local awareness of the species, but further effort is required.

Buxton Gum				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action underway?**
Bushfire	Vegetation management in priority, high-risk areas, where appropriate and in consultation with species experts.	Priority locations	DEECA, FFMVic, land managers	Yes
	Values assessment and asset management advice to mitigate impacts of planned burn operations on public land.	Known habitat (public land)	DEECA Natural Environment Program	Yes
	Education and asset management advice to mitigate impacts of planned burning or other fuel management on private property.	Known occurrences	CMA, land holders, CFA	Partially
	Mapping of known occurrences for inclusion in geospatial databases used in fire response, operations, and risk landscape planning.	Known occurrences	DEECA Natural Environment Program	Yes
All	Investigate options for linking, enhancing, or establishing additional populations.	Known locations (private land, roadsides)	DEECA, CMA (with funding)	Yes – populations enhanced through the Buxton Gum RLP Project 2018-2023 – further funding required for continuation of this work
	Establish or expand on existing monitoring and research programs, including research on biological function, and effects of varying fire frequency/intensity on regeneration and recruitment.		CMA, DEECA Natural Environment Program	No - funding required
	Explore opportunities to collect seed and establish ex-situ populations or reintroduce to sites, where relevant and appropriate.		DEECA, CMA, other partners (e.g. Goulburn Broken Indigenous Seedbank, Botanic Garden)	Yes - further funding required for continuation of this work

Superb Parrot				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action underway?**
Fire	Controlled burns (mosaic burns) to manage vegetation, in consultation with Superb Parrot experts.	Known habitat (public land)	DEECA, FFMVic	Yes
	Values assessment and asset management advice to mitigate impacts of planned burn operations. Consider timing and frequency to minimise impact on flowering and nectar production.	Known habitat (public land)	DEECA Natural Environment Program	Yes
All	Build resilience by improving habitat on public and private land.	Known habitat (public and private land)	Land manager, with support from Trust for Nature, Superb Parrot Project, CMA, DEECA	Yes
	Expand on existing monitoring and research programs, including further surveys to understand limits of extant populations and key nesting sites.		Superb Parrot Project, CMA, DEECA	Partially

Growling Grass Frog				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action underway?**
Bushfire	Vegetation management in priority, high-risk areas.	Priority locations	DEECA, CMA, land managers	Partially
Drought/ Heatwave	Restore and improve condition of streamside habitat.	Priority locations	DEECA, CMA, land managers	Partially
All	Establish or expand on existing monitoring and research programs, including further surveys to understand limits of extant populations.		DEECA, ARI	Yes
	Expand on existing captive breeding program.	Winton Wetlands	Winton Wetlands	Yes
	Expand on existing translocation/reintroduction programs.	Winton Wetlands	Winton Wetlands	Yes
	Identify potential translocation sites to establish new populations.		CMA, DEECA	Partially

Grey-headed Flying Fox				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action current underway?**
Heatwave	Maintain vegetation integrity of camps to allow individuals to naturally move within the camp to cooler areas. The severity of effects of heatwaves on Grey-headed Flying Foxes is likely to be reduced by maintaining: - enough understorey and mid-storey vegetation for shelter from extreme heat, - dense crown vegetation to provide shade, and - access to enough water.	Known camps	DEECA, land managers (e.g. Councils), CMA	Partially

	Develop (or refine existing) incident response protocols relevant to the local area that can be used when flying-fox camps suffer heat stress.	Known camps	DEECA, Wildlife Rehabilitation Organisations, land managers (e.g. Councils)	Unknown
	Encourage use of 'flying fox heat stress forecaster' tool developed by Universities and Bureau of Meteorology, to identify camps where flying-foxes are likely to be exposed to extreme heat up to 72 hours into the future.	Known camps	DEECA, Wildlife Rehabilitation Organisations, land managers (e.g. Councils)	Unknown
	Support research to identify ways of best mitigating the effect of heat stress on juvenile flying-foxes during heat stress events.		DEECA, CMA, Recovery team	Partially
All	Mapping of known camps for inclusion in geospatial databases used in fire response, operations, and risk landscape planning.	Known camps	DEECA Natural Environment Program	Yes
	Continue mapping of new permanent/ semi-permanent camps, and monitoring of existing camps through the National Flying-fox Monitoring Program.		National Flying-fox Monitoring Program, with support from DEECA, CMA	Yes
	Protect and increase roosting habitat and increase extent and viability of foraging habitat that is productive during winter and spring.		DEECA, CMA (with funding)	Unknown
	Develop (or refine existing) camp management plans to prepare for emergency events and support community engagement.		DEECA, land managers (e.g. Councils)	Unknown

Other Threatened Woodland/Grassland Species				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action underway?**
Bushfire	Mosaic burning to enhance habitat, encourage the regeneration of native plant species and support cultural practices. Each community may require different fire regimes depending on vegetation type and location.	Culturally significant sites / ecologically significant sites	First Nations and land managers (e.g. PV)	Partially (DEECA Cultural Burning Officer)
	Research to address knowledge gaps regarding species response to fires of varying intensity/frequency.		DEECA, First Nations, CMA	Partially
All	Build resilience by improving woodland and grassland habitat condition and connectivity on public and private land.	Known locations (public and private land)	Land manager, with support from Trust for Nature, DEECA, CMA (with funding)	Partially
	Establish or expand on existing monitoring and research programs, including further surveys to understand limits of extant populations.		CMA, DEECA Natural Environment Program	Partially
	For flora: explore opportunities to collect seed and establish ex-situ populations or		DEECA, CMA, Recovery	Partially

	reintroduce to sites, where relevant and appropriate.		Teams, other partners (e.g. Goulburn Broken Indigenous Seedbank, Botanic Garden)	

Other Threatened Wetland/Floodplain Species				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action underway?**
Drought	Environmental watering at key sites including the Barmah Forest.	Priority locations	CMA, VEWH, PV, First Nations (Joint Management Plan)	Yes
	Research to address knowledge gaps regarding natural flooding regimes for each species, and their vulnerability to drought of varying duration.		DEECA, CMA, PV	Partially
Bushfire	Mosaic burning to enhance habitat, encourage the regeneration of native plant species and support cultural practices. Individual wetlands may require different fire regimes depending on vegetation type and location.	Culturally significant sites / ecologically significant sites	First Nations and land managers (e.g. PV)	Partially (DEECA Cultural Burning Officer)
	Research to address knowledge gaps regarding species response to fires of varying intensity/frequency.		DEECA, First Nations, CMA	Partially
All	Establish or expand on existing monitoring and research programs, including further surveys to understand limits of extant populations.		CMA, DEECA Natural Environment Program	Partially
	For fauna: establish or expand on existing captive breeding programs or translocation/reintroduction programs, where relevant and appropriate.		DEECA, ARI, CMA, Recovery teams, other partners (e.g. Zoos Victoria)	Partially
	For flora: explore opportunities to collect seed and establish ex-situ populations or reintroduce to sites, where relevant and appropriate.		DEECA, CMA, Recovery Teams, other partners (e.g. Goulburn Broken Indigenous Seedbank, Botanic Garden)	Partially

Other Threatened Montane Forest/Alpine Species				
Emergency scenario	**Actions**	**Where**	**Who**	**Is action underway?**
Bushfire	Vegetation management in priority, high-risk areas, where appropriate and in consultation with species experts.	Priority locations	DEECA, FFMVic, land managers	Yes
	Values assessment and asset management advice to mitigate impacts of planned burn operations.	Known habitat (public land)	DEECA Natural Environment Program	Yes

	Mapping of priority habitat in high-risk areas, for inclusion in geospatial databases used in bushfire response.	Priority locations	DEECA Natural Environment Program	Yes
	Work with First Nations to identify pathways for acknowledgement and implementation of cultural fire practices at landscape scale.	Culturally significant sites / ecologically significant sites	First Nations and land managers (e.g. PV)	Partially (DEECA Cultural Burning Officer)
All	Build resilience by improving habitat condition and connectivity on public and private land.	Known locations (public and private land)	Land manager, with support from Trust for Nature, Alpine Resorts, DEECA, CMA (with funding)	Partially
	Establish or expand on existing monitoring and research programs, including further surveys to understand limits of extant populations.		CMA, DEECA Natural Environment Program	Partially
	Establish or expand on existing captive breeding programs or translocation/reintroduction programs, where relevant and appropriate.		DEECA, ARI, CMA, Recovery teams, other partners (e.g. Zoos Victoria)	Partially

7. BIODIVERSITY ASSETS – RESPONSE ACTIONS

This section outlines response and recovery actions that could be undertaken for each biodiversity asset in response to relevant emergency scenarios such as bushfires, drought, floods, and heatwaves including:

- Where or when the action would need to be undertaken.
- Who could undertake the action.

In cases where there is an active State or National Recovery Team for a particular species or community, actions should be undertaken in consultation with the Recovery Team.

DEECA is the Recovery Coordinating Agency for the following areas related to this Plan (among other areas):

- Natural environment
- Public land and inland waters
- Wildlife and threatened ecosystems and species
- Agriculture.

Specialist Rapid Risk Assessment teams deploy immediately once it is safe post fire to inform emergency recovery actions. Further information is provided in Section 11.

Goulburn Broken CMA is a support agency for flood and other emergencies as required.

Case Study 6: Flood Recovery Project

The Stage 1 Flood Recovery Project delivered a range of bank stabilisation and debris removal and management projects on waterways across the Goulburn Broken Catchment in response to October 2022 flood impacts. On-ground works completed through this program include bank stabilisation works on the Goulburn River at Killingworth using log revetment, rock beaching works on Hughes Creek near Avenel and the repair or replacement of riparian fencing on priority waterways. This project was funded through the 2022-23 Treasurer's Advance Flood Recovery program, administered by DEECA.

Threatened Ecological Communities (response and recovery)

Asset	Emergency scenario	Actions	Where	Who
While event is occurring (response)				
Seasonal herbaceous wetlands of the temperate lowland plains	Drought	Protect vegetation through pest plant and animal control.	Known impact sites.	Land managers, CMA
		Where possible deliver water for the environment.	Known location where water can be delivered.	CMA, VEWH
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Bushfire	Allocate resources to suppress fires if burn frequency and intensity does not match ecological requirements.	Affected sites	Emergency services, DEECA, FFMVic, CFA (private land)
	Drought	Exclude stock and other grazers where possible.	Affected sites	Land managers, CMA
		Monitor impact on vegetation.	Affected sites	Land managers, CMA
Natural Grasslands of the Murray Valley Plains	Drought	Exclude stock and other grazers where possible.	Affected sites	DEECA, land managers, CMA
		Monitor impact on vegetation.	Affected sites	DEECA, land managers, CMA
Alpine Sphagnum Bogs and Associated Fens (and associated fauna)	Bushfire	Allocate resources for rapid fire suppression and/or undertake asset protection of known sites.	Susceptible sites	Emergency services, DEECA, FFMVic, land managers (e.g. PV, Alpine Resorts), with guidance from Recovery Team
		Protect sites from fuel reduction activities, firebreaks, back-burning, and vehicle and machinery movements. Avoid use of fire retardants within and proximal to Alpine Bogs.	Affected sites	Emergency services, DEECA, FFMVic, land managers (e.g. PV, Alpine Resorts)
		Implement use of developed fire management protocols with agencies responsible for Emergency Management: • Work Instruction - "Management of Alpine Peatland Values during Fire Response" • A guide "Response to Bushfire in Alpine Peatlands; a Guideline for Incident Management Teams" • A report "Mitigating the Impact of Fire on Alpine Peatlands "	Affected sites	Emergency services, DEECA, FFMVic, land managers (e.g. PV, Alpine Resorts)
	Drought	Closely monitor vegetation condition and intervene to improve where necessary e.g. weed and pest control.	Affected sites	Land managers (e.g. PV, Alpine Resorts), DEECA, CMA
		Increase feral herbivore control (deer) at affected sites.	Affected sites	DEECA, land manager (e.g. PV, Alpine Resorts)
Grey Box (*Eucalyptus microcarpa*) Grassy	Bushfire	Allocate resources to suppress fires if burn frequency and intensity does not match ecological requirements.	Affected sites	Emergency services, DEECA, FFMVic, CFA (private land)

Asset	Emergency scenario	Actions	Where	Who
Woodlands and Derived Native Grasslands of South-eastern Australia	Drought	Exclude stock and other grazers where possible.	Affected sites	Land managers, CMA
		Monitor impact on vegetation.	Affected sites	DEECA, CMA, land managers
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregion	Bushfire	Allocate resources to suppress fires and/or undertake asset protection of known sites.	Affected sites	Emergency services, DEECA, FFMVic, PV, CFA (private land)
		Protect from accidental damage during fire suppression. For example, when constructing control lines using machinery or undertaking backburning.	Affected sites and surrounds	Emergency services, DEECA, FFMVic, PV, CFA (private land)
	Drought	Increase pest plant and animal control to protect vegetation.	Affected sites	Land managers (e.g. PV), CMA (with funding)
		Where possible deliver water for the environment.	Affected sites where water can be delivered	CMA, VEWH, GMW
After event has occurred (recovery)				
Seasonal herbaceous wetlands of the temperate lowland plains	Drought	Monitor impact on vegetation.	At impact sites	Land managers, CMA
		Ensure immediate and ongoing post-drought pest plant and animal control.	At impact sites	Land managers, CMA
		Where possible, deliver water for the environment.	Known locations where water can be delivered	CMA, VEWH
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Bushfire	Rapid assessment of impact.	Affected sites	DEECA, FFMVic, land managers, CFA (private land)
		Monitor changes in species composition and habitat to provide data on the impacts of the event and inform future planning.	Affected sites	DEECA, FFMVic, CMA
	Drought	Continue to monitor vegetation condition to assess recovery.	Affected sites	Land managers, DEECA, CMA
	Flood	Increase weed control and monitoring.	Affected sites	Land managers, CMA
	All	Ensure ongoing pest plant and animal control.	Affected sites	Land managers, CMA
		Plan for restoration.	Affected sites	DEECA, CMA
Natural Grasslands of the Murray Valley Plains	Drought	Exclude stock and other grazers where possible.	Affected sites	Land managers, CMA
		Continue to monitor vegetation condition to assess recovery.	Affected sites	Land managers, CMA
		Plan for restoration.	Affected sites	DEECA, CMA
Alpine Sphagnum Bogs and Associated	Bushfire	Rapid assessment of impact.	Affected sites	DEECA, FFMVic, land managers (e.g. PV, Alpine Resorts)

Asset	Emergency scenario	Actions	Where	Who
Fens (and associated fauna)		Conduct post-fire assessments of Alpine Peatlands to determine number, scale, and degree of damage, and determine actions and resources necessary for recovery.	Affected sites	DEECA, land managers (e.g. PV, Alpine Resorts), First Nations, research institutions
		Where appropriate, install matting and coir logs to protect peat from further deterioration, and re-establish trapped hydrology.	Affected sites	DEECA, CMA, land managers (e.g. PV, Alpine Resorts), Recovery team
		Monitor changes in hydrology, species composition, and habitat to provide data on the impacts of the event and inform future planning.	Affected sites	DEECA, CMA, land managers (e.g. PV, Alpine Resorts), Recovery team
	Drought	Continue to monitor hydrology and vegetation condition to assess recovery.	Affected sites	Land managers (e.g. PV, Alpine Resorts), ARI DEECA, CMA, research institutions
	All	Increase weed control and feral herbivore control (deer) at affected sites.	Affected sites	Land managers (e.g. PV, Alpine Resorts), DEECA
		Plan for restoration of damaged habitat.	Affected sites	DEECA, CMA, Recovery team
Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Bushfire	Rapid assessment of impact.	Affected sites	DEECA, FFMVic, land managers, CFA (private land)
		Monitor changes in species composition and habitat to provide data on the impacts of the event and inform future planning.	Affected sites	DEECA, FFMVic, CMA
	Drought	Continue to monitor vegetation condition to assess recovery.	Affected sites	Land managers, DEECA, CMA
	Flood	Increase weed control and monitoring.	Affected sites	Land managers, CMA
	All	Ensure ongoing pest plant and animal control.	Affected sites	Land managers, CMA
		Plan for restoration.	Affected sites	DEECA, CMA
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregion	Bushfire	Rapid assessment of impact.	Known impact sites.	DEECA, FFMVic, land managers (e.g. PV), CFA (private land)
	Drought	Continue to monitor vegetation condition to assess recovery.	Affected sites	Land managers, DEECA, CMA
		Where possible continue to deliver water for the environment.	Affected sites where water can be delivered.	CMA, VEWH, GMW
	All	Ensure ongoing pest plant and animal control.	Affected sites	Land managers, CMA
		Plan for restoration.	Affected sites	DEECA, CMA

Barmah Forest Ramsar Site (response and recovery)

Barmah Forest Ramsar Site			
Emergency scenario	**Actions**	**Where**	**Who**
While event is occurring (response)			
Bushfire	Allocate resources to suppress fires and/or undertake asset protection of sensitive/priority areas.	Affected areas	Emergency services, DEECA, land managers (PV, YYNAC)
Drought	Closely monitor vegetation condition and intervene to improve where necessary e.g. weed and pest control.	Priority affected areas	DEECA, CMA
Flood	Monitor flooding situations.	Entire site	Emergency services, CMA
All	Increase monitoring to enable adaptive management as the event progresses.	Affected areas	DEECA, CMA, ARI
	Implement blackwater and species management plans.	Affected areas	DEECA, CMA
	Deliver environmental water where available to combat poor water quality.	Affected areas	DEECA, CMA, VEWH, CEWH
After the event has occurred (recovery)			
Bushfire	Rapid assessment of impact.	Affected areas	Land managers (PV, YYNAV), DEECA, CMA
Drought	Monitor impact on vegetation and water quality.	Affected areas	Land managers (PV, YYNAV), CMA
All	Plan for restoration of damaged habitat.	Known affected habitat	Land managers (PV, YYNAV), DEECA, CMA
	Monitor populations to provide data on the impacts of the event and inform future planning.	Entire site	Land managers (PV, YYNAV), ARI, CMA
	Ensure immediate and ongoing pest plant and animal control.	Entire site	Land managers (PV, YYNAV), CMA (with funding)

Threatened Species (response and recovery)

Threatened fish species			
Emergency scenario	**Actions**	**Where**	**Who**
While event is occurring (response)			
All	Implement blackwater and species management plans.	Affected areas	DEECA, CMA
	Ensure fish passage to enable movement of fish from affected areas to better conditions.	Affected areas	DEECA, CMA, VEWH, CEWH
	Implant aerators to increase oxygen in surrounding area during low dissolved oxygen levels.	Affected areas	DEECA, CMA, ARI
	Increase monitoring; water quality can change very quickly - daily checks may be necessary.	Affected areas	DEECA, CMA, ARI

Threatened fish species			
Emergency scenario	**Actions**	**Where**	**Who**
	If safe to do so, implement fish rescue/relocation plans; removing and translocating vulnerable fish to a safe location e.g. an aquarium or other water system.	Affected areas	DEECA, CMA, ARI, VFA
	Deliver environmental water and/or other source of mitigation water where available to improve water quality.	Affected areas	DEECA, CMA, VEWH, CEWH, GMW
After the event has occurred (recovery)			
Flood	Rapid assessment of impact.	Affected areas	Recovery team
	If safe to do so, continue to implement fish rescue/relocation plans; removing and translocating vulnerable fish to a safe location.	Affected areas	Recovery team, DEECA, CMA, ARI
All	Increase hydrological connectivity; increasing flows to allow genetic mixing and migration to new areas.		DEECA, CMA, VEWH, CEWH
	Manage flow regimes to facilitate natural recruitment and immigration.	Affected areas	DEECA, CMA, VEWH, CEWH
	Continue to implement translocation plans where appropriate: fish from stable unaffected areas can re-populate affected area.	Affected areas	Recovery team, DEECA, CMA, ARI, VFA
	Plan for restoration of damaged habitat.	Affected areas	Recovery team in partnership with land managers, CMA
	Monitor fish populations to provide data on the impacts of the event and inform future planning.	Affected areas	DEECA, CMA, ARI
	Monitor invasive fish species population and distribution	Affected areas	ARI
	Assess condition of invasive fish barriers (Trout barriers etc) to ensure they are functioning.	Affected areas	DEECA, CMA, ARI

Swift Parrot			
Emergency scenario	**Actions**	**Where**	**Who**
While event is occurring (response)			
Bushfire	Allocate resources to suppress fires and/or undertake asset protection of known Swift Parrot habitat.	Known affected or susceptible habitat	Emergency services, DEECA, CFA (private land)
	Protect known habitat from accidental damage during fire suppression e.g. prevent habitat trees being felled during control line construction or hazardous tree work, do not backburn within woodland habitat.	Known affected habitat	Emergency services in consultation with Recovery team, DEECA, CFA (private land)
Drought /Heatwave	Closely monitor habitat condition and intervene to improve where necessary e.g. weed and pest control.	Known affected habitat	DEECA, CMA
After the event has occurred (recovery)			
Bushfire	Rapid assessment of impact.	Affected sites	DEECA, Recovery team
All	Plan for restoration of damaged habitat.	Known affected habitat	Land managers, DEECA, CMA, Recovery team

Regent Honeyeater			
Emergency scenario	**Actions**	**Where**	**Who**
While event is occurring (response)			
Bushfire	Allocate resources to suppress fires and/or undertake asset protection of known Regent Honeyeater habitat.	Known affected or susceptible habitat	Emergency services, DEECA, CFA (private land)
	Protect known habitat from accidental damage during fire suppression e.g. prevent habitat trees being felled during control line construction or hazardous tree work, do not backburn within woodland habitat.	Known affected habitat	Emergency services in consultation with Recovery team, DEECA, CFA (private land)
Drought /Heatwave	Closely monitor habitat condition and intervene to improve where necessary e.g. weed and pest control.	Known affected habitat	DEECA, CMA
After the event has occurred (recovery)			
Bushfire	Rapid assessment of impact.	Affected sites	DEECA, Recovery team
All	Plan for restoration of damaged habitat.	Known affected habitat	Land managers, DEECA, CMA, Recovery team, Regent Honeyeater Project Inc.
	Increase pest predator control.	Known habitat	DEECA, CMA (with funding), Regent Honeyeater Project Inc.

Leadbeater's Possum			
Emergency scenario	**Actions**	**Where**	**Who**
While event is occurring (response)			
Bushfire	Allocate resources to suppress fires and/or undertake asset protection at priority locations.	Affected sites	Emergency services, DEECA, land managers (e.g. PV)
	Protect known populations and habitat from accidental damage during fire suppression e.g. fragmentation through construction of strategic fire breaks.	Affected sites	Emergency services, DEECA, land managers (e.g. PV)
Drought	Closely monitor habitat condition and intervene to improve where necessary e.g. provision of artificial nest boxes.	Affected sites	DEECA, Recovery team, CMA
After the event has occurred (recovery)			
Bushfire	Rapid assessment of impact.	Affected sites	DEECA
	Implement supplementary feeding, where feasible and appropriate, in consultation with species experts. Monitor effectiveness to inform future response.	Known affected habitat	DEECA, Recovery team, land managers (e.g. PV, Alpine Resorts), Zoos Victoria
	Consider translocation, where necessary and appropriate, in consultation with species experts.	Known affected habitat	DEECA, Recovery team, Zoos Victoria
All	Monitor populations to provide data on the impacts of the event and inform future planning.	Known affected habitat	DEECA, CMA, ARI
	Plan for restoration of damaged habitat.	Known affected habitat	DEECA, Recovery team, CMA

	Continue monitoring stag-fall rates at long-term monitoring sites to compare pre/post emergency stag-fall trends, particularly following fire.	Known affected habitat	DEECA, ARI, Universities

Spotted Tree Frog			
Emergency scenario	**Actions**	**Where**	**Who**
While event is occurring (response)			
Bushfire	Allocate resources to suppress fires and/or undertake asset protection of known Spotted Tree Frog habitat.	Known affected habitat	Emergency services, DEECA, in consultation with Recovery team
	Protect known habitat from accidental damage during fire suppression.	Known affected habitat	Emergency services in consultation with Recovery team
Drought (Heatwave)	Implement translocation plans where appropriate.	Known affected habitat	Spotted Tree Frog Recovery Program
	Closely monitor habitat condition and intervene to improve where necessary e.g. weed and pest control.	Known affected habitat	DEECA, CMA
Flood	Closely monitor habitat condition if accessible.	Known affected habitat	DEECA, CMA
After the event has occurred (recovery)			
Bushfire	Rapid assessment of impact.	Affected areas	Recovery team
	Implement reintroduction where appropriate.	Affected areas	Spotted Tree Frog Recovery Program
All	Plan for restoration of damaged habitat.	Known affected habitat	DEECA, CMA, Recovery team
	Monitor populations to provide data on the impacts of the event and inform future planning.	Known affected populations	DEECA, CMA, ARI, Spotted Tree Frog Recovery Program

Round-leaf Pomaderris			
Emergency scenario	**Actions**	**Where**	**Who**
While event is occurring (response)			
Bushfire	Allocate resources to suppress fires and/or undertake asset protection at priority locations.	Affected sites	Emergency services, DEECA, CFA (private land)
	Protect known populations from accidental damage during fire suppression.	Affected sites	Emergency services, DEECA, CFA (private land)
Drought	Closely monitor habitat condition and intervene to improve where necessary e.g. weed and pest control, particularly control of sambar deer (*Cervus unicolor*).	Affected sites	DEECA, CMA
After the event has occurred (recovery)			
Bushfire	Rapid assessment of impact.	Affected sites	DEECA
All	Monitor populations to provide data on the impacts of the event and inform future planning.	Affected sites	DEECA, CMA, ARI
	Plan for restoration of damaged habitat.	Known affected habitat	DEECA, CMA

	Increase control of sambar deer (*Cervus unicolor*) in affected areas.	Known affected habitat	DEECA, land managers (e.g. PV)
	Implement national translocation protocols if establishing additional populations is considered necessary and feasible.	Known affected habitat	DEECA, CMA (with funding)

Spiny Rice-flower			
Emergency scenario	**Actions**	**Where**	**Who**
While event is occurring (response)			
Bushfire	Allocate resources to suppress fires and/or undertake asset protection at priority locations.	Affected sites	Emergency services, DEECA, CFA
	Protect known populations from accidental damage during fire suppression.	Affected sites	Emergency services, DEECA, CFA, Campaspe Shire Council
After the event has occurred (recovery)			
Bushfire	Rapid assessment of impact.	Affected sites	DEECA
	Monitor populations to provide data on the impacts of the event and inform future planning.	Affected sites	DEECA, CMA, Campaspe Shire Council
	Plan for restoration of damaged habitat.	Known affected habitat	DEECA, CMA, Campaspe Shire Council
	Implement national translocation protocols if establishing additional populations is considered necessary and feasible.	Known affected habitat	DEECA, CMA (with funding)

Australasian Bittern			
Emergency scenario	**Actions**	**Where**	**Who**
While event is occurring (response)			
Bushfire	Allocate resources to suppress fires and/or undertake asset protection of known Australasian Bittern habitat.	Known affected habitat	Emergency services, DEECA
Drought	Closely monitor habitat condition and intervene to improve where necessary e.g. weed and pest control.	Known affected habitat	Land managers, DEECA, CMA, First Nations
	Deliver water for the environment where possible, in line with species requirements.	Known locations where water can be delivered.	CMA, VEWH
After the event has occurred (recovery)			
Bushfire	Rapid assessment of impact.	Known affected habitat	Land managers, DEECA
Drought	Continue to deliver water for the environment where possible, in line with species requirements.	Known affected locations where water can be delivered.	CMA, VEWH
All	Monitor populations to provide data on the impacts of the event and inform future planning.	Affected sites	DEECA, CMA, research partners

	Ensure immediate and ongoing pest predator control.	At Affected sites	Land managers, CMA (with funding)
	Plan for restoration of damaged habitat.		Land managers, CMA, Emergency Recovery Victoria, and Biodiversity Recovery Working Group (led by DEECA)

Mountain Pygmy-possum			
Emergency scenario	**Actions**	**Where**	**Who**
While event is occurring (response)			
Bushfire	Allocate resources to suppress fires and/or undertake asset protection at priority locations, consistent with species and habitat requirements	Affected sites	Emergency services, DEECA, FFMVic, land managers (Alpine Resorts, PV)
	Protect known populations and habitat from accidental damage during fire suppression, e.g. avoid use of fire retardants or mineral earth breaks within and surrounding habitat areas.	Affected sites	Emergency services, DEECA, FFMVic, land managers (Alpine Resorts, PV)
Drought/ Heatwave	Increase predator control and monitoring (cats, foxes).	Affected sites	Land managers (Alpine Resorts, PV), CMA (with funding), First Nations
	Where necessary and appropriate, consider provision of supplementary food and/or water either aerially or via feeders. Species-specific supplementary food (Bogong Bikkies) has been developed, trialled, and used safely after emergencies (NSW). Feeders developed and available. Aerial drone feeder (ZENA) developed and ready for deployment.	Affected sites, where suitable and in extreme scenarios	Land managers (Alpine Resorts, PV), Zoos Victoria
	Where necessary and appropriate, consider rescue (evacuation) to ex situ emergency holding facility. Bio-secure enclosures developed and available (Healesville Sanctuary) for emergency extractions. Husbandry and techniques for collections, holding, and release successful and available.	Affected sites, where suitable and in extreme scenarios	DEECA, Zoos Victoria, PV
After the event has occurred (recovery)			
Bushfire	Rapid assessment of impact.	Affected sites	DEECA, land managers (Alpine Resorts, PV)
	Where necessary and appropriate, consider triage of injured or displaced animals, and/or rescue (evacuation) to ex situ emergency holding. Veterinary mobile triage units and vets are available for deployment. Veterinary facilities available at Healesville Sanctuary, Melbourne Zoo, and Werribee Open Range Zoo, and bio-secure alpine-mimicking enclosures available at Healesville Sanctuary.	Affected sites, where suitable and in extreme scenarios	DEECA, Zoos Victoria, State Wildlife Emergency Support Network (WESN)
All	Monitor populations to provide data on the impacts of the event and inform future planning.	Affected sites	DEECA, CMA, ARI
	Increase predator control and monitoring (cats, foxes).	Affected sites	Land managers (Alpine Resorts, PV), CMA (with funding), First Nations

	Where necessary and appropriate, consider provision of supplementary food and/or water either aerially or via feeders. Species-specific supplementary food (Bogong Bikkies) has been developed, trialled, and used safely after emergencies (NSW). Feeders developed and available. Aerial drone feeder (ZENA) developed and ready for deployment.	Affected sites, where suitable and in extreme scenarios	Land managers (Alpine Resorts, PV), Zoos Victoria
	Plan for restoration of damaged habitat e.g. revegetation with key food and structural plant species.	Known affected habitat	Land managers (Alpine Resorts, PV), CMA (with funding), First Nations, Recovery Team

Stiff Groundsel			
Emergency scenario	**Actions**	**Where**	**Who**
While event is occurring (response)			
Bushfire	Allocate resources to suppress fires and/or undertake asset protection at priority locations.	Affected sites	Emergency services, DEECA, CFA (private land)
	Protect known populations from accidental damage during fire suppression.	Affected sites	Emergency services, DEECA, CFA (private land), Campaspe Shire Council
Drought	Closely monitor habitat condition and intervene to improve where necessary e.g. weed and pest control.	Affected sites	DEECA, CMA
	Where possible, deliver water for the environment.	Affected sites where water can be delivered	CMA, VEWH, GMW
After the event has occurred (recovery)			
Bushfire	Rapid assessment of impact.	Affected sites	DEECA
All	Monitor populations to provide data on the impacts of the event and inform future planning.	Affected sites	DEECA, CMA, Campaspe Shire Council
	Plan for restoration of damaged habitat.	Known affected habitat	DEECA, CMA, Campaspe Shire Council
	Implement national translocation protocols if establishing additional populations is considered necessary and feasible.	Known affected habitat	DEECA, CMA (with funding)

Lima Stringybark			
Emergency scenario	**Actions**	**Where**	**Who**
While event is occurring (response)			
Bushfire	Allocate resources to suppress fires and/or undertake asset protection at priority locations.	Affected sites	Emergency services, DEECA, CFA (private land)
	Protect known populations from accidental damage during fire suppression.	Affected sites	Emergency services, DEECA, CFA (private land), Benalla Rural City Council
Drought	Closely monitor habitat condition and intervene to improve where necessary e.g. weed and grazing control.	Affected sites	DEECA, CMA

After the event has occurred (recovery)			
Bushfire	Rapid assessment of impact.	Affected sites	DEECA
All	Monitor populations to provide data on the impacts of the event and inform future planning.	Affected sites	DEECA, CMA, Benalla Rural City Council
	Plan for restoration of damaged habitat.	Known affected habitat	DEECA, CMA, Benalla Rural City Council, Swanpool Landcare Group (with support)

Buxton Gum			
Emergency scenario	**Actions**	**Where**	**Who**
While event is occurring (response)			
Bushfire	Allocate resources to suppress fires and/or undertake asset protection at priority locations.	Affected sites	Emergency services, DEECA, CFA (private land)
	Protect known populations from accidental damage during fire suppression.	Affected sites	Emergency services, DEECA, CFA (private land)
All	Closely monitor habitat condition and intervene to improve where necessary e.g. weed and pest control.	Affected sites	DEECA, CMA
After the event has occurred (recovery)			
Bushfire	Rapid assessment of impact.	Affected sites	DEECA
All	Monitor populations to provide data on the impacts of the event and inform future planning.	Affected sites	DEECA, CMA
	Plan for restoration of damaged habitat.	Known affected habitat	DEECA, CMA

Superb Parrot			
Emergency scenario	**Actions**	**Where**	**Who**
While event is occurring (response)			
Bushfire	Allocate resources to suppress fires and/or undertake asset protection of known Superb Parrot habitat.	Known affected habitat	Emergency services, DEECA, CFA (private land)
	Protect known habitat from accidental damage during fire suppression e.g. prevent habitat trees being felled during control line construction or hazardous tree work, do not backburn within woodland habitat.	Known affected habitat	Emergency services in consultation with Recovery team, DEECA, CFA (private land)
Drought/ Heatwave	Closely monitor habitat condition and intervene to improve where necessary e.g. weed and pest control.	Known affected habitat	DEECA, CMA
After the event has occurred (recovery)			
Bushfire	Rapid assessment of impact.	Affected sites	DEECA, Recovery team
All	Plan for restoration of damaged habitat.	Known affected habitat	Land managers, DEECA, CMA, Recovery team

Growling Grass Frog			
Emergency scenario	**Actions**	**Where**	**Who**
While event is occurring (response)			
Bushfire	Allocate resources to suppress fires and/or undertake asset protection of known Growling Grass Frog habitat or reintroduction sites.	Known affected habitat	Emergency services, DEECA, in consultation with Recovery team
	Protect known habitat from accidental damage during fire suppression, e.g. mineral earth control lines.	Known affected habitat	Emergency services in consultation with Recovery team.
Drought/ Heatwave	Implement translocation plans where appropriate.	Known affected habitat	DEECA, CMA
	Closely monitor habitat condition and intervene to improve where necessary e.g. weed and pest control.	Known affected habitat	DEECA, CMA, ARI
	Where possible, deliver water for the environment.	Affected sites where water can be delivered.	VEWH, CMA, GMW
Flood	Closely monitor habitat condition if accessible.	Known affected habitat.	DEECA, CMA, ARI
After the event has occurred (recovery)			
Bushfire	Rapid assessment of impact.	Affected areas	Recovery team
	Implement reintroduction where appropriate.	Known affected habitat	Recovery team
All	Plan for restoration of damaged habitat.	Known affected habitat	DEECA, CMA, Recovery team
	Monitor populations to provide data on the impacts of the event and inform future planning.		DEECA, CMA, ARI

Grey-headed Flying Fox			
Emergency scenario	**Actions**	**Where**	**Who**
While event is occurring (response)			
Heatwave	Implement incident response plans specific to individual camps.	Affected camps	DEECA, Wildlife Rehabilitation Organisations, land managers (e.g. Councils)
	Take great care to avoid unnecessarily disturbing flying-foxes during heatwave events. Disturbance may force individuals to leave their cooler microhabitats and become fully exposed to the extreme heat.	Affected camps	Public, land managers (e.g. Councils)
	If necessary and appropriate, experienced wildlife carers may intervene directly by, for example: - spraying flying-foxes in the camp with water, or - removing flying-foxes from a camp for treatment.	Affected camps	Wildlife Rehabilitation Organisations
Bushfire	Allocate resources to suppress fires and/or undertake asset protection at priority locations.	Affected camps	Emergency services, DEECA, land managers (e.g. Councils)

	Protect known populations and habitat from accidental damage during fire suppression.	Affected camps	Emergency services, DEECA, land managers (e.g. Councils)
Drought	Closely monitor habitat condition and intervene to improve where necessary e.g. weed and pest control.	Affected habitat (roosting and foraging)	DEECA, Recovery team, CMA
After the event has occurred (recovery)			
Heatwave	Monitor and report on the impact of heatwave events, including their location and frequency, to understand the impact of heat stress on recovery.	Affected camps	National Flying-fox Monitoring Program, with support from DEECA, CMA
Bushfire	Rapid assessment of impact.	Known affected habitat (roosting and foraging)	DEECA
All	Monitor populations to provide data on the impacts of the event and inform future planning.	Affected camps	DEECA, CMA, ARI
	Plan for restoration of damaged habitat.	Known affected habitat (roosting and foraging)	DEECA, Recovery team, CMA

Other Threatened Woodland/Grassland Species			
Emergency scenario	**Actions**	**Where**	**Who**
While event is occurring (response)			
Bushfire	Allocate resources to suppress fires and/or undertake asset protection at priority locations.	Affected sites	Emergency services, DEECA, CFA (private land)
	Protect known populations and habitat from accidental damage during fire suppression.	Affected sites	Emergency services, DEECA, CFA (private land)
Drought	Closely monitor habitat condition and intervene to improve where necessary e.g. weed and pest control.	Affected sites	DEECA, CMA
After the event has occurred (recovery)			
Bushfire	Rapid assessment of impact.	Affected sites	DEECA
All	Monitor populations to provide data on the impacts of the event and inform future planning.	Affected sites	DEECA, CMA, ARI
	Plan for restoration of damaged habitat.	Known affected habitat	DEECA, CMA, Recovery teams

Other Threatened Wetland/Floodplain Species			
Emergency scenario	**Actions**	**Where**	**Who**
While event is occurring (response)			
Bushfire	Allocate resources to suppress fires and/or undertake asset protection at priority locations.	Affected sites	Emergency services, DEECA, CFA (private land)
	Protect known populations and habitat from accidental damage during fire suppression.	Affected sites	Emergency services, DEECA, CFA (private land)
Drought	Closely monitor habitat condition and intervene to improve where necessary e.g. weed and pest control.	Affected sites	DEECA, CMA
	Where possible, deliver water for the environment.	Affected sites where water can be delivered.	CMA, VEWH, GMW
After the event has occurred (recovery)			
Bushfire	Rapid assessment of impact.	Affected sites	DEECA
All	Monitor populations to provide data on the impacts of the event and inform future planning.	Affected sites	DEECA, CMA, ARI
	Plan for restoration of damaged habitat.	Known affected habitat	DEECA, CMA, Recovery team

Other Threatened Montane Forest/Alpine Species			
Emergency scenario	**Actions**	**Where**	**Who**
While event is occurring (response)			
Bushfire	Allocate resources to suppress fires and/or undertake asset protection at priority locations.	Affected sites	Emergency services, DEECA, CFA (private land)
	Protect known populations and habitat from accidental damage during fire suppression.	Affected sites	Emergency services, DEECA, CFA (private land)
Drought	Closely monitor habitat condition and intervene to improve where necessary e.g. weed and pest control.	Affected sites	DEECA, CMA
After the event has occurred (recovery)			
Bushfire	Rapid assessment of impact.	Affected sites	DEECA
All	Monitor populations to provide data on the impacts of the event and inform future planning.	Affected sites	DEECA, CMA, ARI
	Plan for restoration of damaged habitat.	Known affected habitat	DEECA, CMA, Recovery teams

8. AGRICULTURAL NATURAL CAPITAL ASSETS - IDENTIFICATION AND SUSCEPTIBILITY

This section identifies the Goulburn Broken catchment's agricultural natural capital assets. The Goulburn Broken catchment is comprised of six socio-ecological systems (SES) that share similar social, economic, and ecological characteristics as outlined below and in Figure 1 (GB CMA 2024).

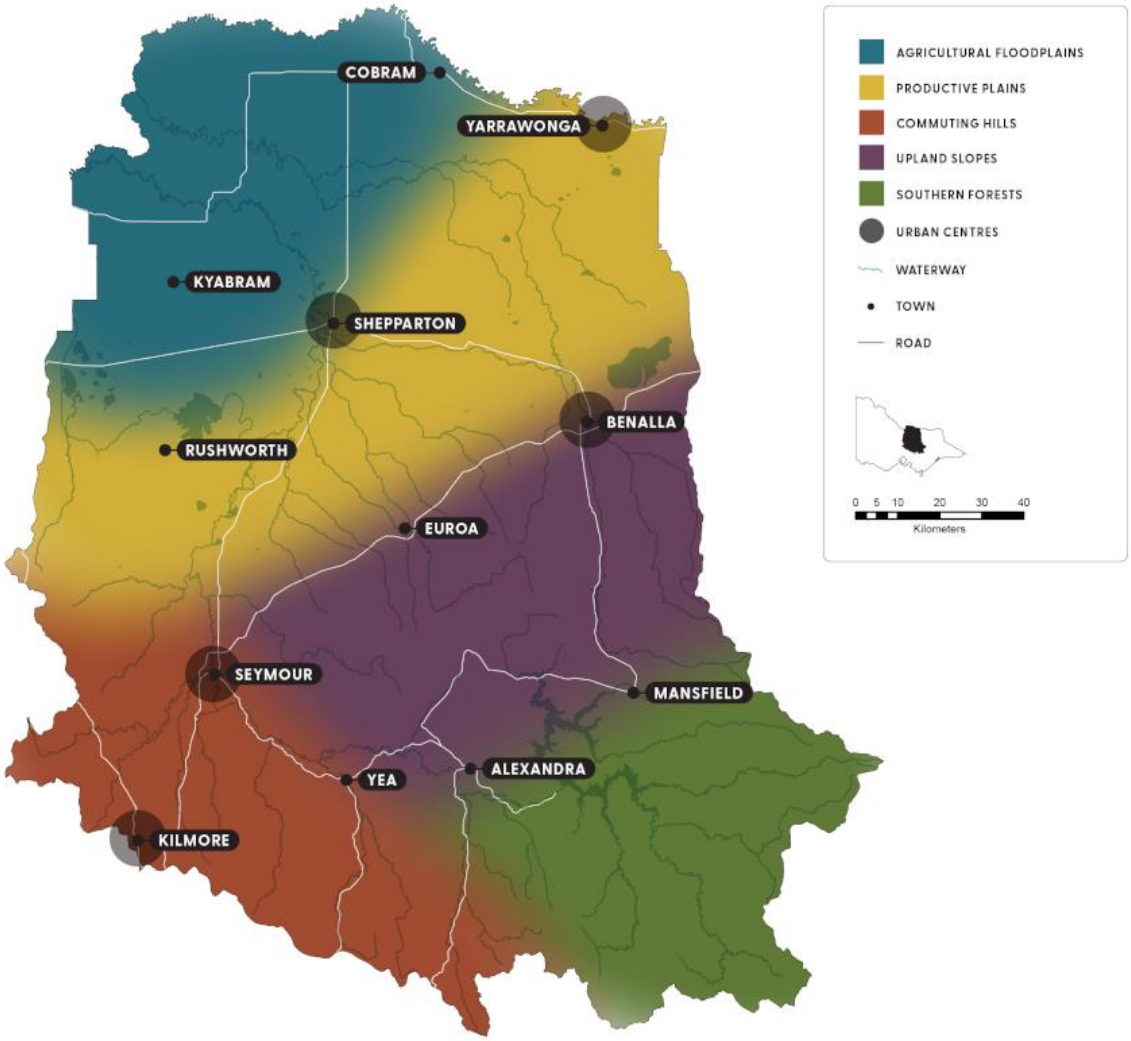


Figure 1 The six social-ecological systems (SES) of the Goulburn Broken catchment

Agricultural Floodplains SES encompass the Shepparton Irrigation Region and the north-eastern parts of the catchment to the Murray River. The region has a rich Aboriginal heritage and a First Nations population of more than 6,000, the largest in regional Victoria. The major agricultural industries are dairying, and stone and pome fruit production, which support a large food processing industry. Changing land use have impacted the area's biodiversity, with most of the remaining habitat and vegetation along waterways and roadsides.

Productive Plains SES occurs across the lower slopes and plains of the central part of the catchment. The area's abundant food and water resources were first used by the Yorta Yorta and Taungurung Clans. Most of the remaining habitat is provided by vegetation along waterways, roadsides, ranges, and spring soak wetlands.

Commuting Hills SES feature the mountainous urban fringe of the southern and south-western area of the catchment. European settlement led to the clearing of land for agriculture, gold rushes, urban development and rail and road infrastructure. Large tracts of public land and small privately owned forested land remain over much of the area. Public land use includes extensive native forests, recreation, and production forestry. Private land use is typically for lifestyle properties, intensive agriculture (such as berry farming and aquaculture) and grazing on cleared valleys and slopes.

Upland Slopes SES extend across the southern hills and valleys of the catchment. The Taungurung were the first people of the rivers, valleys, and mountains in this region. Forests originally covered the hills, and the valleys were open grassy woodlands. More recently, the area has been dominated by agricultural land and lifestyle properties.

Natural events, such as drought and bushfires have also shaped the landscape. Agricultural practices are dominated by grazing with some intensive agriculture such as viticulture and irrigated agriculture along waterways. Land use is changing with the introduction of different crops, such as cherries, and the growth in lifestyle properties, particularly in the Strathbogie Ranges and around the larger towns.

Southern Forests SES local area in the catchment's south and south-east includes seasonally snow-covered alps, moist montane and sclerophyll forests. The Taungurung were the first people of this area and have on-going land management responsibilities through the Recognition and Settlement Agreement between the Taungurung Land and Waters Council Aboriginal Corporation, the Taungurung Traditional Owner group, and the state government. The public land has the largest intact native vegetation areas in the catchment. The natural resources are used for forest reserve, recreation, tourism, hydropower, water capture and storage and production forestry, including native forests and plantations. The forest landscapes are highly valued for their ecological extent and diversity, cultural significance and economic contribution from recreation, tourism, plantation, and native forest timber harvesting. Soils are fragile and often on steep slopes. The ecosystem services include high-quality and reliable water that provide environmental, economic, and social value.

Urban Centre SES are the smallest sub-catchment system by area but contain the largest populations. They are defined by a concentration of people, services, and industries. Urban communities are very diverse and connected by employment, sporting, and social groups, but may not be strongly connected to the natural environment. This connection is changing with developments capitalising on the natural environment and a growing number of people enjoying nature-based recreation.

Catchment Agricultural Assets

Agricultural natural-capital assets are the natural resources on farms that support food and fibre production. These include soil, air, water, riparian areas, remnant native vegetation, agroforestry, and environmental plantings. Land, soil, and climate are fundamental to the natural environment, supporting ecosystems and agricultural communities. Approximately 1.4 million hectares of the Goulburn Broken catchment are used for dryland agriculture, and 270,600 hectares for intensive irrigated agriculture. In the irrigated landscapes, cropping and dairy are the two most extensive land uses, followed by grazing (non-dairy) and horticulture (perennial and non-perennial). In dryland landscapes, cropping, animals (e.g. beef, sheep, horses), and wineries dominate, with an increasing diversity of agricultural pursuits (GB CMA 2024).

This Plan focuses on the natural capital assets on farms that support agricultural production, specifically:

- Agricultural soils.
- Water sources (e.g. rivers, wetlands, natural water bodies).
- On-farm vegetation including environmental plantings, riparian areas, agroforestry, and remnant native vegetation.

Agricultural commodities themselves such as livestock, crops, and their quality, are outside the scope of this document.

Grouped by Socio-Ecological Systems (SES), agricultural assets were prioritised for inclusion based on the following criteria:

- Located/situated where likelihood, frequency and/or severity of emergency events is significantly high.
- Located/situated where GB CMA have capacity to take impactful action before, during, or after an emergency event.

Appendix 1, Figure 27 shows the location of agricultural land in the Goulburn Broken catchment, indicating where agricultural soils and native vegetation on farms are located.

Appendix 2 provides a multi-jurisdictional inventory of assets, outlining the relevant legislation and policies by jurisdiction.

The Goulburn Drought Resilience Plan is coordinated by the Goulburn Broken Catchment Management Authority. Goulburn regional drought resilience is described as the ability to thrive and flourish and to transform where needed, it is not always about resist and persist. The Goulburn Drought Resilience Plan is funded through the Future Drought Fund and DEECA, having been developed by regional stakeholders to increase regional resilience to the impacts of drought.

Agricultural soils

Soils are an important natural-capital asset underpinning the region's valuable agricultural industry. Healthy soils support the production of food and fibre as well as the region's natural landscapes.

The management of soils influences the health of natural assets, such as native vegetation and waterways by providing a healthy foundation for plants and animals and acting as a buffer to prevent sediments entering waterways.

Agricultural natural capital asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Agricultural soils **Agricultural Floodplain, Productive Plains, Commuting Hills SES**	Bushfire	Wildfire on farms removes ground cover and soil organic matter, exposing soils and making them susceptible to erosion by wind and rain. Erosion impacts on soil fertility and productivity by removing productive topsoil, nutrients, and carbon.	High	Exposed soil leading to wind and water erosion is a significant threat to soil health and function. Wind and water erosion following fires can occur across the catchment, especially in the Northern (wind erosion) and Upper Catchment area (water erosion). Water erosion is of particular concern in the Upper Catchment. Fires are challenging to manage in this hilly landscape and can burn large areas. The risk of paddock soils and waterways eroding during rainfall events increases substantially when ground cover is low or absent. Fires in the Agricultural Floodplains SES are generally easier to control because of the relatively flat terrain and lack of heavy fuel loads, however, have become more frequent and intense due to changing land use such as cropping in place of annual pasture.
	Flood	River and stream flooding and overland flow have the potential to erode agricultural soils in all soil types. Inundation by flood water of agricultural land increases the risk of soil salinisation through recharging of saline shallow groundwater tables.	Medium	Soils are more susceptible to erosion if ground cover is low or absent due to land management practices, wildfire, or drought. Soil erosion caused by flooding can occur across the catchment. It occurs most frequently in the Upper Catchment where hillslopes are steeper. Soils with compaction and low soil carbon are more susceptible to erosion and are impaired in their ability

Agricultural natural capital asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
				to capture and absorb water. Flood inundation of agricultural land can recharge shallow saline groundwater tables, common in the agricultural landscapes, leading to salinisation of soil.
	Drought /Heatwave	Drought can reduce ground cover through overgrazing and creation of bare ground. Overgrazing can occur by domestic livestock, native and feral grazers.	High	Soils are more susceptible to erosion if ground cover is low or absent. Drought increases grazing pressure on ground cover. Drought also reduces plant productivity and soil organic carbon if it is extreme or prolonged. Reduced soil organic carbon increases susceptibility of soil to structural decline and erosion.

Riparian areas, native vegetation, agroforestry and environmental plantings on farms

Private land covers two-thirds of the Goulburn Broken catchment, of which approximately 10-20% is covered by native vegetation in small and large patches that are of varying quality. Importantly, 70% of native species rely on private land for all or some of their life cycle. Private land management has a significant stewardship role in the protection and enhancement of native vegetation (GB CMA 2024).

Native vegetation on farms occurs as remnant or revegetated patches large and small, isolated paddock trees, and in riparian zones beside waterways. Agroforestry involves managing trees and shrubs on farms to provide benefits important to the farmer. Riparian areas, native vegetation, and agroforestry and environmental plantings on farms provide a variety of benefits to agricultural production and biodiversity conservation:

- Providing habitat for beneficial insects that support agricultural production as predators of pest insects and as pollinators.
- Providing shade and shelter to livestock, pastures, and crops, improving livestock and pasture/crop health, and reducing stress.
- Storing carbon and, where accredited, offsetting against a farm business's greenhouse gas emissions.
- Producing timber.
- Rehabilitating unproductive land such as saline or eroded areas.
- Improving the amenity of a property.

Native vegetation on farms is extremely important in supporting and maintaining biodiversity. It provides habitat for many species and ecosystems and acts as stepping stones and pathways for species to move through the agricultural landscape between patches of suitable habitat.

Agricultural natural capital asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Vegetation	Bushfire	Wildfire can burn vegetation, impacting on the benefits	Medium	Given the number and breadth of values these assets provide

Agricultural natural capital asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
• **Riparian areas** • **Native vegetation** • **Agroforestry** • **Environmental plantings on farms – for a range of purposes (e.g. carbon, biodiversity, salinity protection, soil health)** **All SES except Urban SES**		provided by these areas on farms. For example, it can: • Displace birds and insects affecting pollination of adjacent agricultural plants. • Remove ground cover making soil susceptible to erosion. • Decrease vegetation value as shelter and windbreaks, particularly for agroforestry and shelterbelts that may use species that are not necessarily adapted to fire.		to agriculture the impacts can be high or vary. Some areas might recover over time, while others might be damaged beyond repair, depending on the degree of other stressors they face and their capacity to recover.
	Flood	A flood can disperse weeds along floodplains and threaten the benefits provided by these areas, including outcompeting flora that support agricultural natural capital.	Medium	Experience has shown weeds become prevalent following floods, particularly where the native cover was impacted prior and weed seed is able to succeed.
		Soil erosion can occur if ground cover is low or absent around trees and shrubs.	Medium	Soils are more susceptible to erosion from flooding/inundation if ground cover is low or absent due to land-management practices like overgrazing, fire, or drought. Soil erosion caused by flooding can occur across the catchment.
	Drought/ Heatwave	Drought may cause vegetation stress or mortality, impacting the benefits provided on farms.	Medium	Drought increases pressure on vegetation on farms where livestock and other grazers have access. Highly sensitive areas such as riparian zones are likely to experience significant stress from grazing and trampling resulting in defoliation and soil compaction, leading to greater risk of plant mortality and soil erosion.

Water

Integrated management of surface and sub surface (groundwater) water resources across the Goulburn Broken catchment seeks to ensure that water tables and water quality remain at healthy levels for multiple uses, including agriculture. In dryland areas, some farmers use bore water for both stock and domestic supplies whilst some have catchment dams or off-stream watering systems. Many waterway tributaries are intermittent and can be dry during certain times of year or for extended periods depending on rainfall.

The majority of the Shepparton Irrigation Region (SIR) is contained within the Goulburn Broken catchment, with the western part in the North Central catchment (e.g. Rochester). The SIR is a critically important region for food production in Australia, with an annual economic output of $4.5 billion. Management of land and water within the SIR is guided by the Shepparton Irrigation Region Land and Water Management Plan (GB CMA 2024). Landholders have access to a state-of-the-art irrigation system, which received $2 billion in investment during 2016 to 2024. The system is heavily regulated and reliant on dam storage (e.g. Eildon, Hume), river delivery (e.g. Murray and Goulburn Rivers) and connected channels and on-farm irrigation systems (e.g. channels, reuse systems and automated irrigation) through private water use licences. Limited or capped water, combined with lower reliability in a drying climate, continues to threaten the viability of irrigated agriculture.

Agricultural natural capital asset	Emergency scenario	Why it poses a threat	Susceptibility	Why
Water **(all surface and subsurface sources)** **All SES**	Bushfire	Bushfire can impact catchments that feed farm dams and waterways on farms. Fire removes ground cover, increasing the risk of soil and debris erosion by wind and water in the initial period after a fire until vegetation recovers. Water erosion can move ash, silt, debris, and organic material into dams and waterways, making the water unattractive to livestock and possibly leading to toxic algal growth. The quantity of water running off into dams and waterways can decrease as vegetation regrows following bushfire, impacting on water availability.	High	Water quality can be impacted in the short term, following a bushfire, particularly if large rainfall or wind events occur. In the first few years of regeneration following a bushfire, water quantity can decline significantly before a gradual return. This can have a significant impact on water availability both in storage and for water in the landscape. Both are important in supporting agriculture.
	Drought/ Heatwave	Drought directly impacts the available water in the landscape which is vital for growing food and fibre. Water quality can decline, concentrating salt or nutrients, leading to blue green algal blooms. A lack of water in the landscape can impact crop pollinators. Heatwaves can impact crops and horticulture growth and require increased use of irrigation water to keep crops growing in times of stress.	Medium	Drought and heatwaves are becoming more common under climate change, particularly at unseasonal times (heatwaves) increasing the difficulty of preparing for such conditions.

9. AGRICULTURAL NATURAL CAPITAL ASSETS – PREPAREDNESS ACTIONS

This section outlines preparedness actions that could be undertaken for agricultural natural-capital assets in the Goulburn Broken catchment to reduce the threat of relevant emergency scenarios such as bushfires, drought, heatwaves, and floods. Tables for each asset include:

- Suggested preparedness actions.
- Where the action should be undertaken.
- The organisation or group that could undertake or is already undertaking the action.

Case studies or examples are included below where these actions have been undertaken previously in the Goulburn Broken catchment.

Case Study 7: Employment program to implement natural resource management actions during drought:

In 2017-2020, the Drought Employment Program was undertaken, which was a highly successful project involving intense on-ground works across the Goulburn Broken Catchment. The Goulburn Broken Catchment Management Authority Drought Employment Program provided full-time employment for up to six months for more than 70 farmers affected by drought. Employees worked in supervised crews on projects aimed at protecting and enhancing natural resources at icon sites across the catchment.

The result was a win for the environment and a win for families facing the worst drought on record, creating much needed employment, and implementing critical natural resource management works. The program provided work for farmers, farm workers or farm service providers affected by the drought. Employees received first aid, chemical handling, occupational health and safety and chainsaw training. Funded by the Department of Sustainability and Environment as part of the Victorian Government's statewide Drought Response Package, the GB CMA received about $3 million to implement the program. "These drought employment projects are providing an income for drought-affected rural Victorians as well as helping local communities and their environment," Water Minister (at the time) John Thwaites said.

Work completed included: 60kms of fencing along the Broken, Boosey and Nine Mile Creeks and the Goulburn River; Two bird hides built at Gemmill's Wetland, Mooroopna; Seats built at Jordan's Bend; Fish habitat created on the Broken Creek; Muster yards built at Barmah State Park; Parks Victoria signage at Yarrawonga; Rubbish removal along Murray River from Cobram to Yarrawonga and on the Goulburn River in Shepparton; Signage at the Dharnya Centre, Barmah State Forest; Weed control carried out across more than 400 ha of public land; and 824 metre wheels maintained to achieve water savings.

Case Study 8: GB CMA assesses waterways impacted by flooding:

Throughout 2023, the Goulburn Broken CMA assessed waterways impacted by the October to November 2022 floods. This work continued in response to further flood events in Spring 2023 and Summer 2024. Flood recovery funding initially targeted works of an urgent nature, such as debris management, as access conditions improved. Common impacts to waterways and riparian land from flooding include erosion of the bed and banks of waterways, build-up of large wood and debris, damage, or loss of waterway assets (such as riparian fencing and erosion control structures), poor water quality, impacts to habitat and native plants and animals and subsequent spread of pest plants and animals.

During 2023, GB CMA also used limited available funds to undertake and support higher priority works needed to protect waterways and public assets, such as: Waterways or riparian fence repair; Erosion and sediment management; and Revegetation and weed control.

In April 2024, GB CMA received additional State Government funding to support a second stage of flood recovery works. This stage will enable GB CMA to complete a program of previously assessed and unfunded priority works and activities on flood affected waterways.

Note: FFMVic (Forest Fire Management Victoria) can deploy Rapid Risk Assessment Teams during emergencies to identify and prioritise risk treatment options and activities to undertake as part of recovery on public land.

Agricultural soils (preparedness)

Asset	Emergency scenario	Actions	Where	Who	Is action currently underway?
Agricultural soils **Agricultural Floodplain, Productive Plains, Commuting Hills SES**	Bushfire	Develop and implement farm fire preparedness /property plans.	Private land	Private landholders, Ag Vic, CFA, Landcare	Yes, in parts
		Create and/or maintain strategic fuel breaks.	Private land	Private landholders	Yes, in parts
	Flood	Support landholders to maintain ground cover, aiming for >70% cover.	All floodplain areas	All land managers	Yes – CMA and partner organisations i.e. Ag Vic and Landcare promote this and monitor outcomes
		Test soils and document soil health to improve understanding of how to improve soils with compaction and low soil carbon susceptible to erosion.	All of catchment/ private land	DEECA, CMA, private land holders	No, funding is required
		Establish Drainage Course Declarations to remove obstructions on natural drainage courses enhancing drainage.	Shepparton Irrigation Region	GMW, CMA	Yes, as part of Land & Water Management Plan but speed of action limited by funding
		Monitor shallow groundwater levels through established monitoring network and start groundwater pumps to lower the water table when trigger levels are reached.	Shepparton Irrigation Region	GMW, CMA	Yes, as part of Land and Water Management Plan
		Encourage the adoption of whole farm plans so that any earthworks undertaken on a property do not compromise catchment drainage.	Shepparton Irrigation Region	CMA, Ag Vic, Local Government	Yes, as part of Land and Water Management Plan
	Drought /Heatwave	Encourage landholders to maintain ground cover, aiming for >70% cover.	All of catchment/ private land	Private landholders	Yes – CMA and partner organisations i.e. Ag Vic and Landcare promote this and monitor outcomes
		Support farmers to prepare drought preparedness plans.	Private land, Hume Region - Goulburn Drought Resilience Plan	Private landholders, Goulburn Drought Resilience Plan partners.	Yes – Ag Vic, MLA, VFF, Landcare

Riparian areas, native vegetation, agroforestry and environmental plantings on farms (preparedness)

Asset	Emergency scenario	Actions	Where	Who	Is action currently underway?
Vegetation • **Riparian areas** • **Native vegetation** • **Agroforestry** • **Environmental plantings on farms – for a range of purposes (e.g. carbon, biodiversity, salinity protection, soil health)** **All SES except to a lesser extent Urban SES**	Bushfire	Fuel-reduction burns in private forests and woodlands.	All of catchment	Private landholders, CFA, DEECA	Extent unknown
		Develop and implement farm fire preparedness toolkit or Bushfire Plan	Private land	Private landholders, Ag Vic, CFA, Landcare	Yes, in parts
		Create and/or maintain strategic fuel breaks on farms that protect the asset.	Private land	Private landholders	Yes
	Drought	Continue to implement native vegetation on private land to create wind breaks and provide shade/refuge for stock in agricultural areas.	Private land	Private landholders, CMA, TFN.	Yes, where funding is available on private land
		Implement native grass trials on agricultural land to increase perennial groundcover.	Private land	Private landholders, industry group trials	Minimal
		Identify and build awareness of the native vegetation linkages that are a priority under a range of climate scenarios.	Hume Region – Goulburn Drought Resilience Plan	Private landholders, Goulburn Drought Resilience Plan partners	Yes, CMAs, DEECA
		Protect remnant vegetation from overgrazing and severe animal impact.	Private land, crown land with grazing access	Private landholders, CMA	Yes, in parts. Funding dependent
	Flood	Control invasive weeds in riparian areas to reduce weed spread.	Floodplain areas	CMA and partner organisations such as Landcare DEECA, Parks Victoria.	Yes – partially
		Revegetate banks and fence off waterways to improve long-term resilience and reduce the risk of erosion from flooding.	All floodplain areas	Private land managers, CMA, Landcare.	Yes, as part of Waterway Strategy, but dependent on funding

Water (preparedness)

Asset	Emergency scenario	Actions	Where	Who	Is action currently underway?
Water **(all surface and subsurface sources)**	Bushfire	Implement fuel reduction burns in heavily vegetated areas to protect critical water infrastructure.	All of catchment	DEECA, private landholders, First Nations	Yes, as per DEECA and land manager fire plans

Asset	Emergency scenario	Actions	Where	Who	Is action currently underway?
All SES		Implement alternative water supply in remnant areas to enable fire prevention where access is an issue.	All of catchment	DEECA, private landholders, First Nations	Yes, as per DEECA and land manager fire plans
		Review emergency water points (locations, ownership, operation, maintenance) to ensure access.	All of catchment Also noted as action in Goulburn Drought Resilience Plan.	FFMVic, CFA	Further work to occur
	Drought	Catchment planning e.g. Groundwater Management, Irrigation Management	Irrigation areas of the catchment e.g. Agricultural Floodplains	Water authorities e.g. GMW, CMA	Yes
		Water Use Efficiency Measures implemented e.g. tanks, reuse systems, efficient irrigation technology.	Private land. Also noted as an action in Goulburn Drought Resilience Plan (water use efficiency).	Private landholders, CMAs, Ag Vic (DEECA)	Yes, particularly SIR, Agricultural Floodplain SES, and where funding is available in dryland areas (e.g. Productive Plains SES)
		Protection of wetlands / farm dams as drought refugia	Private land (farm dams)	Private landholders, Landcare, CMA, TFN	Yes, where funded
		Implement Soil Moisture Monitoring technology and monitoring systems to enable efficient water application.	Agricultural private land.	Private landholders, CMA, Ag Vic (DEECA), Industry groups (e.g. Irrigated Cropping Council, Murray Dairy)	Yes, where funded
		Strengthen forecasts and communication about water availability under predicted climate scenarios including drought.	Hume Region – Goulburn Drought Resilience Plan.	Goulburn Drought Resilience Plan partners	Yes, partially
		Build the awareness and skills of community about drought preparedness.	Hume Region – Goulburn Drought Resilience Plan.	Goulburn Drought Resilience Plan partners	Yes, partially

Asset	Emergency scenario	Actions	Where	Who	Is action currently underway?
		Produce education and communication materials on water use (efficiency, allocations, and its distribution) to the various water users in community (urban, rural, brokers, groundwater).	Hume Region – Goulburn Drought Resilience Plan.	Goulburn Drought Resilience Plan partners	Yes, partially
		Promote, encourage, and coordinate programs and learning activities for water management on irrigated farms and orchards.	Hume Region – Goulburn Drought Resilience Plan.	Goulburn Drought Resilience Plan partners	
		Promote, encourage, and coordinate programs and learning activities to enhance storage of livestock feed for drought preparedness.	Hume Region – Goulburn Drought Resilience Plan.	Goulburn Drought Resilience Plan partners	
		Invest in research to understand and quantify underground water resources, inflow volumes and associated ecological change during drought.	Hume Region – Goulburn Drought Resilience Plan.	Goulburn Drought Resilience Plan partners	Yes, GMW
		Encourage continuous policy review to manage competing water needs under changing climate.	Hume Region – Goulburn Drought Resilience Plan.	Goulburn Drought Resilience Plan partners	Yes, DEECA, First Nations (Water is Life)
	Flood	Maintain groundcover and buffer zones to minimise erosion, resulting high nutrient run-off, and poor water quality.	Floodplain areas, riparian areas, catchment areas.	Private landholders, CMA, Landcare	Yes – CMA and partner organisations i.e. Agriculture Victoria and Landcare promote this and monitor the outcomes

10. AGRICULTURAL NATURAL CAPITAL ASSETS – RESPONSE ACTIONS

This section outlines response and recovery actions that could be undertaken for each agricultural natural-capital asset in response to the relevant emergency scenarios such as bushfires, drought, floods, and heatwaves including:

- Where or when the action would need to be undertaken.
- Who could undertake the action.

A case study is included below where these actions have been undertaken previously in the Goulburn Broken catchment.

Case Study 9: Use of Goulburn Broken Community Flood Intelligence Portal during flood response:

A key role of the Goulburn Broken CMA is to find out how far floodwaters are likely to extend and how high they are likely to rise. Flood Impacts in the catchment are significant, resulting in road closures, loss of access for residents, disruption to schools, property isolation, risks to emergency personnel during sand bagging and evacuation operations and damage to buildings constructed below flood level. During major floods such as those experienced in October 2022, there was also substantial rural and infrastructure flood damages. Councils also have a responsibility to consider any land subject to flooding in their planning, zoning and development approvals and work with the CMA in this regard. The CMA and Councils have a joint responsibility to provide property specific flood information to property owners, developers, and other interested stakeholders. The Goulburn Broken Community Flood Intelligence Portal was developed by the Goulburn Broken CMA and Councils (Greater Shepparton City, Benalla Rural City, Moira Shire, Strathbogie Shire, Mitchell Shire and Murrindindi Shire) to provide this information to landholders and enable them to view flood maps, search properties and create a property flood report and flood information including estimated 100-year ARI flood levels. This flood risk information is paramount to improved flood resilience. The sharing of flood risk information is thus an important pathway to create better flood resilient communities.

Agricultural soils (response and recovery)

Asset	Emergency scenario	Actions	Where	Who
While event is occurring (response)				
Agricultural soils **Agricultural Floodplain, Productive Plains, Commuting Hills SES**	Bushfire	Allocate resources to suppress fires and/or undertake protection of known assets from fire and accidental damage during fire suppression.	Affected areas	Emergency services, private landholders, CFA
		Activate farm fire preparedness toolkit or Bushfire Plan.	Affected areas	Private landholders
	Flood	Initiate Flood Response Action Plan as per Goulburn Broken Waterways Strategy, Goulburn Broken Floodplain Management Strategy.	Affected areas e.g. riverine areas.	Emergency services and partners e.g. CMA, all land managers
		Provide technical information on flooding impacts i.e. flood prediction, modelling, assessment, flood intelligence tool.	Affected areas	Emergency services, CMA
		Livestock management to reduce stock loss.	Affected areas	Emergency services, private landholders, CMA
	Drought	Livestock management to minimise loss of groundcover.	Affected areas	Private landholders
		Focus on people and support programs, including implementing Drought Employment Program that enables farm businesses to retain employees during drought.	Affected areas	Private landholders, Ag Vic, DEECA, CMA

Asset	Emergency scenario	Actions	Where	Who
	All	Monitor/assess impacts.	Known impact sites	Emergency services/response (e.g. DEECA Rapid Response Team, Ag Vic, Local Government), private land managers, CMAs
After event has occurred (recovery)				
Agricultural soils **Agricultural Floodplain, Productive Plains, Commuting Hills SES**	All	Rapid assessment of impact.	Known impact sites	Private landholders, Ag Vic, DEECA Rapid Response Team, CMA
		Focus on people and support.	Affected areas	Ag Vic, DEECA, CMA, Health Services, Local Government
	Bushfire	Plan for restoration – Re-establish ground cover as quickly as possible following fire, reinstate fences.	Known impact sites	Private landholders, Ag Vic, DEECA, CMA
	Flood	Assess options for best fence locations and reinstate damaged fences.	Known impact sites	Private landholders
		Plan for restoration – e.g. in-stream habitat and erosion control.	Priority impact sites	Private landholders, CMA
	Drought	Plan for restoration and planning for future droughts.	Known impact sites	Private landholders, Ag Vic, DEECA, CMA

Riparian Areas, Native Vegetation, Agroforestry and Environmental Plantings on Farms (response and recovery)

Asset	Emergency scenario	Actions	Where	Who
While event is occurring (response)				
Vegetation • **Riparian areas** • **Native vegetation** • **Agroforestry** • **Environmental plantings on farms – for a range of purposes (e.g. carbon, biodiversity, salinity**	Bushfire	Allocate resources to suppress fires and/or undertake protection of known assets from fire and accidental damage during fire suppression.	Affected areas	Emergency services, private landholders, CFA
		Activate farm fire preparedness toolkit or Bushfire Plan.	Affected areas	Private landholders
	Flood	Initiate Flood Response Action Plan as per Goulburn Broken Waterways Strategy, Goulburn Broken Floodplain Management Strategy.	Affected areas e.g. riverine areas.	Emergency services and partners e.g. CMA, all land managers
		Provide technical information on flooding impacts i.e. flood prediction, modelling, assessment, flood intelligence tool.	Affected areas	Emergency services, CMA (with State funding)

Asset	Emergency scenario	Actions	Where	Who
protection, soil health) **All SES except Urban SES**	Drought	Maintain vegetation cover, including perennial groundcover to increase resilience to dry condition and minimise loss of priority habitat.	Affected areas	CMA, private landholders
		Focus on people and support programs, including implementing Drought Employment Program that enables farm businesses to retain employees during drought.	Affected areas	Private landholders, Ag Vic, DEECA, CMA
	All	Monitor/assess impacts.	Known impact sites	Emergency services/response (e.g. DEECA Rapid Response Team, Ag Vic, Local Government), private land managers, CMAs
After event has occurred (recovery)				
Vegetation • **Riparian areas** • **Native vegetation** • **Agroforestry** • **Environmental plantings on farms – for a range of purposes (e.g. carbon, biodiversity, salinity protection, soil health)** **All SES except Urban SES**	All	Rapid assessment of impact.	Known impact sites	Private landholders, Ag Vic, DEECA Rapid Response Team, CMA
		Focus on people and support.	Affected areas	Ag Vic, DEECA, CMA, Health Services, Local Government
	Bushfire	Plan for restoration – Re-establish plants as quickly as possible following fire, reinstate fences.	Known impact sites	Private landholders, Ag Vic, DEECA, CMA
	Flood	Assess options for best fence locations and reinstate damaged fences.	Known impact sites	Private landholders
		Plan for restoration – e.g. in-stream habitat and erosion control.	Priority impact sites	Private landholders, CMA
		Implement Employment-based Program.	Impacted Local Government Areas	CMA, Local Government, Victorian Government
	Drought	Plan for restoration and planning for future droughts.	Known impact sites	Private landholders, Ag Vic, DEECA, CMA

Water (response and recovery)

Asset	Emergency scenario	Actions	Where	Who
While event is occurring (response)				
Water **(all surface and subsurface sources)**	Bushfire	Allocate resources to suppress fires and/or undertake protection of known waterways and wetlands from fire and accidental damage during fire suppression.	High risk fire areas, and high priority waterways and wetlands	Emergency services, private landholders, CFA, CMA

Asset	Emergency scenario	Actions	Where	Who
All SES	Flood	Initiate Flood Response Action Plan as per Goulburn Broken Waterways Strategy, Goulburn Broken Floodplain Management Strategy.	Affected areas e.g. riverine areas.	Emergency services and partners e.g. CMA, all land managers e.g. DEECA
		Provide technical information on flooding impacts i.e. flood prediction, modelling, assessment, flood intelligence tool.	Affected areas	Emergency services, CMA
	Drought	Allocation of resources for fodder, livestock management.	Affected areas	Ag Vic, DEECA
		Implement groundcover management e.g. Stock Containment Areas.	Affected areas	Ag Vic, DEECA, CMA, Landcare, private landholders
		Implement extension events to support impacted landholders to manage impact e.g. field walk and talk events.	Affected areas	Ag Vic, DEECA, CMA, Landcare, Industry e.g. Murray Dairy, Irrigated Cropping Council
	All	Monitor/assess impacts.	Known impact sites	Emergency services/response (e.g. DEECA Rapid Response Team, Ag Vic, Local Government), private land managers, CMAs
After event has occurred (recovery)				
Water **(all surface and subsurface sources)** **All SES**	All	Rapid assessment of impact e.g. at water points, waterways, and wetlands.	Known impact sites	Private landholders, Ag Vic, DEECA Rapid Response Team, CMA
		Focus on people and support.	Affected areas	Ag Vic, DEECA, CMA, Health Services, Local Government
	Bushfire	Plan for restoration – re-establish vegetation cover as quickly as possible.	Priority impact sites	Private landholders, CMA, Ag Vic
		Implement monitoring.	Known impact sites	Private landholders, CMA, Ag Vic, DEECA
	Flood	Reinstate damaged water infrastructure, tanks, pumps (electricity).	Known impact sites	Private landholders, Ag Vic, DEECA, Power Authorities
	Drought	Extension services to support changed land practices and restoration.	Affected areas	Ag Vic, DEECA, CMA, Landcare

11. EMERGENCY MANAGEMENT IN VICTORIA

The ***Victorian Emergency Management* (EM) *Act 2013*** establishes Victoria's emergency management framework. Establishment of Emergency Management Victoria, who supports the Emergency Management Commissioner, has overall responsibility for coordination before, during and after major emergencies, including management of the consequences of an emergency. The Emergency Management Commissioner is responsible for arranging for the preparation of a state emergency management plan.

The **Victorian State Emergency Management Plan** 2023 provides for an integrated, coordinated, and comprehensive approach to emergency management at the state level. The SEMP The State Emergency Management Plan (SEMP) outlines roles and responsibilities for emergency management in Victoria for mitigation, response, relief, and recovery. State Emergency Management Plan (SEMP).pdf (emv.vic.gov.au)

The State Emergency Management Planning Committee (SEMPC), Regional Emergency Management Planning Committees (REMPCs) and Municipal Emergency Management Planning Committee (MEMPCs) are comprised of representatives from:

- Specified government departments - Department of Premier and Cabinet and Department of Treasury and Finance, Department of Families, Fairness and Housing, Department of Health.
- Agencies - Victoria Police, Fire Rescue Victoria, Country Fire Authority, Ambulance Victoria, State Emergency Services, Emergency Management Victoria.
- Relevant municipal councils.
- Other specialist emergency management agencies and stakeholders - Australian Red Cross, one recovery representative (CEO), one other representative, one community representative.

The *EM Act* requires the preparation of **Regional Emergency Management Plans** (REMPs) by Regional Emergency Management Planning Committees (REMPC) and approved by the Emergency Management Commissioner.

The Goulburn Broken catchment is part of the Hume emergency management region. The Hume Region is in the northeast of Victoria and shares boundaries with four Victorian EM regions (Loddon Mallee, North and West Metro, East Metro and Gippsland, as well as New South Wales. It incorporates the alpine region, including alpine resorts of Falls Creek, Lake Mountain, Mt Buller, Mt Stirling, and Mt Hotham, and extends to the Murray River region (Barmah to Corryong). Dinner Plain is also located in the alpine region, consisting of privately owned properties, and will be managed under the Alpine Shire MEMP. The alpine resort of Mt Baw Baw is also included in Hume for emergency management planning purposes; operational response will be tended to by Gippsland Region. The Hume Region includes two sub-regions (Goulburn and Ovens Murray) which are serviced by twelve Local Government Areas and the six alpine resorts under the auspice of Alpine Resorts Victoria (REMPC 2023).

REMPCs are multi-agency collaborations with membership comprising organisation, industry, and personal expertise relevant to regional emergency management planning. Wimmera CMA is an active member of the Grampians Regional Emergency Management Planning Committee.

The Hume Regional Emergency Management Plan 2023 seeks to reduce the likelihood of emergencies, the effect of emergencies on communities, and the consequences of emergencies for communities. The REMP supports holistic and coordinated emergency-management arrangements within the region and is a subordinate plan to the SEMP.

This REMP documents the agreed emergency-management arrangements for mitigation, response, relief, and recovery and defines the roles and responsibilities of stakeholders at the regional level.

Municipal Emergency Management Plans (MEMPs) are prepared by Municipal Emergency Management Planning Committees. MEMPs document the agreed emergency-management arrangements for mitigation, response, and recovery, and define the roles and responsibilities of stakeholders at the municipal level. At the local level, a MEMP contextualises its REMP and is informed by local and municipal risks. There are thirteen MEMP's for the Hume Region including, Greater Shepparton, Alpine, Benalla, Indigo, Mansfield, Mitchell, Moira, Murrindindi, Strathbogie, Towong, Wangaratta, Wodonga, and Alpine Resorts Victoria (pending boundary changes).

A **Community Emergency Management Plan** is also in place for Woods Point, which comes under the Mansfield MEMP.

Figure 22 depicts each of these Plans under Victoria's emergency management planning framework.

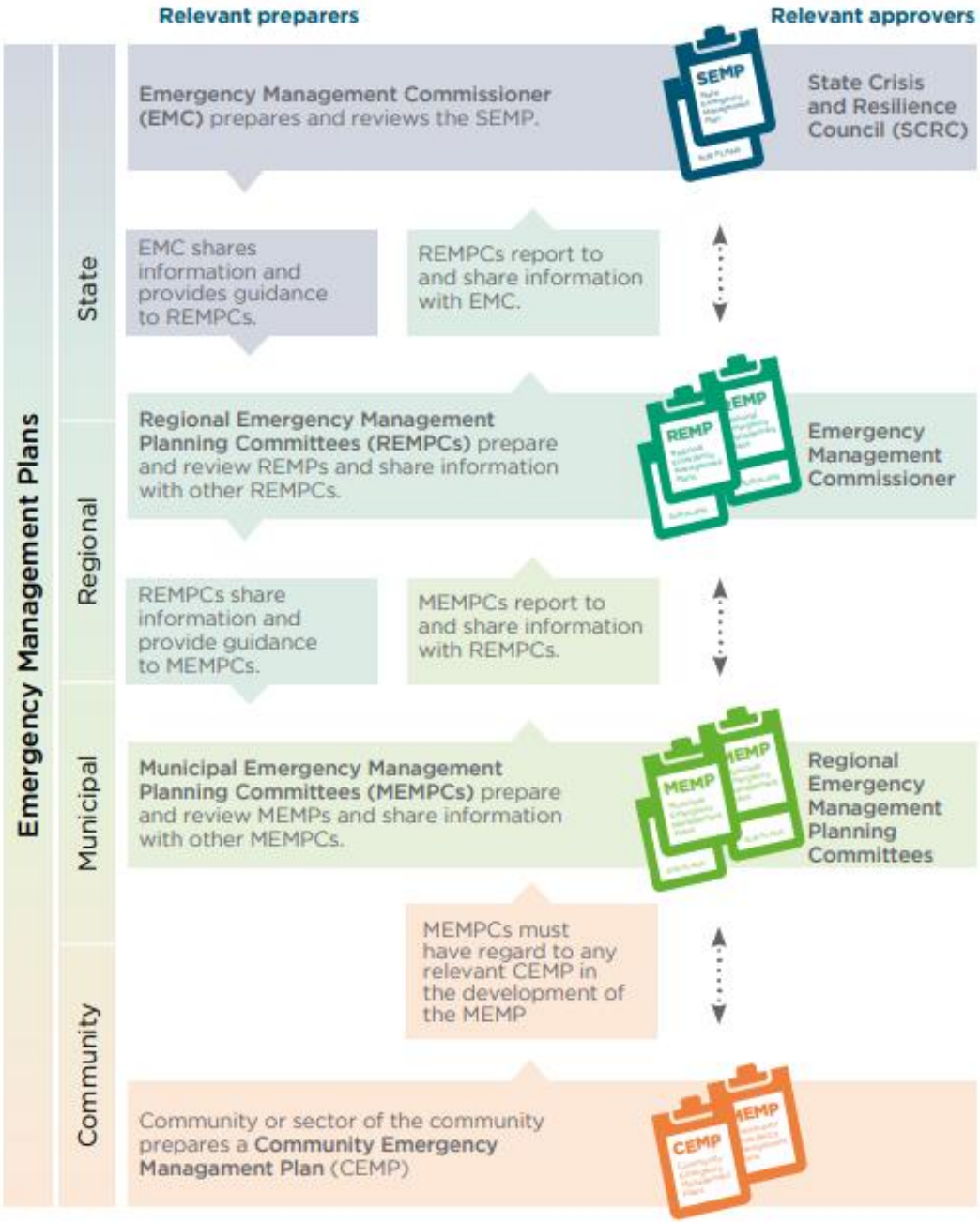


Figure 2. Framework for emergency management planning (Victoria) (EMV 2023)

12. ORGANISATIONAL AND RESPONSIBILITIES (KEY CONTACTS)

There is a magnitude of organisations that play important roles in regional emergency management. The table below lists organisations involved in emergency preparedness, response, and recovery in relation to biodiversity and agricultrual natural assets, and what their role is in relation to this Plan. The Plan does not list contact names and details because they are subject to frequent change.

Key lead and supporting organisations involved in emergency preparedness, response, and recovery in the Goulburn Broken catchment.

Organisation	Role
Agricultural extension and industry groups.	Extension and industry groups strongly influence natural resource management through their networks and advisory roles. These organisations partner with Goulburn Broken CMA on sustainable-agriculture projects and activities, including supporting farmers to restore riparian vegetation and retain ground cover to protect natural capital, including during and after bushfire, flood, and drought. Key groups include Fruit Growers Victoria, Murray Dairy, Victorian Farmers Federation, Irrigated Farmers Network, Vic NoTill, Riverine Plains Inc., Grains Research and Development Corporation, Horticulture Innovation Australia, and Meat & Livestock Australia.
Country Fire Authority (CFA) / Fire Rescue Victoria.	The CFA is a large volunteer-based emergency-service organisation. The CFA works with Victoria's emergency services to fulfil its mission to protect lives and property through operational response and the promotion of community safety and education. The CFA plays a role in implementing this plan to protect biodiversity and agricultural natural-capital assets when performing its operations. The CFA works with Victorian fire-fighting agency Fire Services Victoria.
Goulburn Broken CMA	The Goulburn Broken CMA is responsible for the integrated planning and coordination of land, water, and biodiversity management in the Goulburn Broken catchment. It is responsible for coordinating regional investment in integrated catchment management and provides a link between local communities, Victorian and Australian Governments. It does so with funding from the Victorian Government (DEECA) and the Australian Government (DAFF and DCCEEW). The Goulburn Broken CMA carries out several statutory functions including floodplain management and delivery of water for the environment. It has a key role to advise on flood mitigation, provide support to flood response, and lead flood-recovery programs where resources are available to conduct works. The CMA also provides support and advise to emergency-service organisations in other areas of expertise.
Goulburn-Murray Rural Water Corporation (Goulburn-Murray Water)	Goulburn–Murray Water is a statutory authority of the Victorian Government, providing bulk water storage and supply services to people of Northern Country/North Central Victoria and the Southern Riverina regions. As the northern Victorian Resource Manager appointed by the Minister for Water, Goulburn-Murray Water is responsible for making the seasonal determination for all northern Victorian declared water systems. Goulburn–Murray Water manages bulk water supplies to local government–owned water utilities, provides flood mitigation services, and provides irrigation services. They manage, store, and deliver water through delivery and drainage infrastructure, as well as managing water storages and the public land that surrounds them.
Goulburn Valley Region Water Corporation (Goulburn Valley Water)	Goulburn Valley Water is a state-owned Government Business Enterprise (GBE). They are a statutory corporation responsible to the Minister for Water. Their core purpose is to deliver water services to residential, commercial, and industrial customers within their region, which encompasses the Goulburn Broken catchment. They are responsible for managing water and wastewater services and associated infrastructure.
Landcare (Networks).	Gecko Clan Landcare Network, Goulburn Murray Landcare Network, Upper Goulburn Landcare Network, and the Hughes Creek Catchment Collaborative, are community-based organisations that provide support to Landcare Groups and landholders in their local areas through leadership, planning and resources.

Organisation	Role
Non-Government Organisations E.g. Local farming, conservation, and waterway protection groups: Landcare groups, 'Friends of' groups, river-improvement committees, Wetland working groups.	The Goulburn Broken Catchment's volunteer groups mobilise community involvement, attract corporate, philanthropic and government funding and influence and implement significant parts of the strategy in local areas. This is usually with an emphasis on local-scale on-ground works including invasive plant and animal control, revegetation, waterway monitoring and improving farming practices. Winton Wetlands is a large NGO undertaking significant biodiversity and restoration works.
Local Government.	Responsible for localised services including emergency management such as response and recovery. Have a legislated role to assist with local planning and preparation for emergency events. This involves leading the preparation of Municipal Emergency Management Plans (MEMP) and coordinating MEMP Committee meetings involving local emergency-management agencies.
Parks Victoria.	A statutory authority established to protect, conserve, and enhance Parks Victoria-managed land, including its natural and cultural values, for the benefit of the environment and current and future generations consistent with the Parks Victoria Act 2018. Parks Victoria plays a significant role in fire and emergency management as a support agency and partner in the whole-of-government planning and response program. Parks Victoria supports DEECA to prepare for, respond to and recover from bushfires on public land. Parks Victoria also has a key support role in other emergency events. Parks Victoria works in partnership with DEECA responding to bushfires and conducting planned burns and other fuel-management activities under the brand 'Forest Fire Management Victoria' (FFMVic). Parks Victoria also engages in a comprehensive monitoring and research program informing bushfire-management planning. This includes pre-fuel and post-fuel hazard monitoring, projects relating to ecosystem reliance, evidence-based management and application of ecological fire and post-fire regeneration in fire-sensitive bioregions (Parks Victoria 2024).
Taungurung Land and Waters Council.	Registered Aboriginal Party under the Victorian *Aboriginal Heritage Act 2006* for Taungurung Country. Represent the interests of Taungurung people and serves to uphold their interests with respect to culture and country. In their role as a service provider for natural resource management, TLaWC liaise with government bodies, private landowners, developers, and other stakeholders to assist with applying best land and water management practices to ensure environmental and cultural heritage preservation.
Trust for Nature.	Responsible for helping people protect biodiversity on private land. This includes conservation covenants, land-management stewardship, Revolving Fund program, land ownership and management and assistance in arranging native-vegetation offsets. Trust for Nature can support and facilitate fire on private land for asset management and threatened species purposes.
Victorian Government Department of Energy, Environment and Climate Action (DEECA).	DEECA brings together Victoria's energy, environment, water, agriculture, forestry, resources, climate action and emergency-management functions into a single department to maximise connections between the environment, community, industry, and economy. DEECA aims to improve Victoria's liveability with a population that is expected to almost double by 2050, while responsibly taking climate action and protecting the natural environment, infrastructure, and heritage for future generations.
DEECA - Agriculture Victoria.	Agriculture Victoria works with the agriculture industry on research, development, and extension to improve production, develop preparedness through planning, connect the sector with international markets, support development and maintain effective biosecurity controls. Agriculture Victoria works with Victorian farmers and industry to prepare for, respond to and recover from natural disasters, including floods and storms. This includes delivering technical information and supporting events to support farm-business recovery. Agriculture Victoria also works with

Organisation	Role
	industry, community, and other government agencies to respond to biosecurity outbreaks. Agriculture Victoria is a lead regulator for Biosecurity, including: • The lead agency for managing biosecurity legislative outcomes and biosecurity threats within Victoria. • Working with the Commonwealth and other state and territory governments to enhance Australian and Victorian biosecurity through national committees, working groups, production of standards and shared emergency management exercises. • Collaborating with other Victorian government departments to ensure the effective delivery of biosecurity outcomes and compliance and to ensure enforcement is delivered within this system. • Working with local government and community groups to promote shared responsibility within our biosecurity system.
DEECA - Forest Fire Management Victoria (FFMVic).	FFMVic's core purpose is to protect people, property, and the environment by managing bushfires and bushfire risk in Victoria's parks, forests, and other public land, and by minimising the impact of fire on communities and the environment. This management includes risk-based bushfire management and planning; fire prevention and preparedness; fuel-management programs (including planned burning) as outlined in regional Joint Fuel Management Plans; and emergency response and recovery.
Victorian Government Department of Transport and Planning (DTP).	DTP's key responsibility for emergency management is to minimise the impact of emergencies across its portfolio areas through effective preparation, coordination, response, and recovery. DTP's role in this Plan is in relation to biodiversity assets on roadsides managed by DTP.
Victoria Police (VicPol).	VicPol's role is to serve the Victorian community and uphold the law to promote a safe, secure, and orderly society through preserving the peace, protecting life and property, preventing the commission of offences, detecting, and apprehending offenders and helping those in need of assistance. VicPol has emergency-management control and coordination functions, as outlined in the *Emergency Management Act 2013* and the SEMP.
Victoria State Emergency Service (VicSES).	VicSES is a volunteer-based organisation that provides emergency assistance to minimise the impact of emergencies and strengthen the community's capacity to plan, respond and recover, when emergencies occur. VicSES is the control agency for storm, flood, earthquake, tsunami, and landslide throughout Victoria.
Yorta Yorta Nation Aboriginal Corporation (YYNAC)	Registered Aboriginal Party under the Victorian *Aboriginal Heritage Act 2006* for Yorta Yorta Country. Custodians of traditional ecological knowledge and cultural heritage across Yorta Yorta Country. YYNAC have a key role in natural resource management and planning, including the protection and enhancement of cultural values and integration of Yorta Yorta perspectives, knowledge, and cultural management practices.
Yorta Yorta Traditional Owner Land Management Board (TOLMB)	The Yorta Yorta Traditional Owner Land Management Board was formed as part of an agreement signed between the Yorta Yorta Nation Aboriginal Corporation and the State of Victoria to nurture Barmah National Park back to health through a Joint Management Plan.

*Note: This table does not include organisations such as Ambulance Victoria, Department of Families, Fairness and Housing who are involved in emergency management but not the agricultural and biodiversity components outlined in this Plan.

13. COMMUNITY AND STAKEHOLDER ENGAGEMENT

This section outlines the Goulburn Broken CMA's approach to developing and communicating this plan to stakeholders, including how we will support (and integrate this plan into) Commonwealth, State, and Territory government efforts to identify and incorporate biodiversity and agricultural natural capital assets into emergency response management and planning systems.

Partnerships have been the foundation of natural resource management (NRM) in the Goulburn Broken catchment for over 25 years. This partnership approach to NRM is reflected in Victorian Government legislation and delivery frameworks, which support Integrated Catchment Management through mechanisms including Regional Catchment Strategies and Regional Partnership Agreements across the 10 Victorian Catchment Management Authority areas.

The *Catchment and Land Protection* (CaLP) *Act 1994* promotes co-operation of persons and bodies involved in land, water, and biodiversity management in the region. The renewal, coordination, and implementation of the Goulburn Broken Regional Catchment Strategy is an example of how this partnership approach guides regional planning and on-ground actions across the catchment. This partnership approach was utilised throughout development of this Plan consisting of the following key stages of engagement:

1. Socialising the background and context to the Plan and the reasons for its development to partners and seeking their feedback on ways to be involved. This often occurred at existing partnership forums, or via meetings, phone calls and follow up emails.
2. Meeting with VicCatchment CMAs and Melbourne Water to discuss efficiency measures to share data sources.
3. Meeting with a range of Geographic Information System specialists to discuss required and potential data sources.
4. Meeting with partners / technical specialists to request and discuss Plan sections for feedback.
5. Researching existing strategies for actions, priority assets etc.
6. Providing Plan sections to partners / technical specialists for input.
7. Including partners / technical specialists into the Plan.
8. Feedback received through ongoing consultation with stakeholders was incorporated into the Plan, however, ongoing adaptive planning is required to ensure the most appropriate preparedness, recovery, and response efforts.
9. Ongoing efforts to raise public awareness and promote the document where possible.
10. Ongoing efforts to adapt the Plan and integrate where possible with Commonwealth, State and Territory governments efforts.

Key gaps

Where possible, gaps in preparedness, response and recovery actions for assets have been identified in the tables included in Sections 6-10 of this Plan. For example, actions such as research or monitoring tasks have been included that are designed to fill identified gaps. General gaps affecting many species include:

- There is a gap in up-to-date information regarding the locations of many species and/or the persistence of species where observation records are historic. Further survey and monitoring work to identify the locations of threatened species and communities is required to feed into emergency preparedness, response, and recovery actions.
- There are some species where the impact of emergencies is unknown and further work is required to ensure appropriate management is implemented and unintended impacts are avoided (e.g. Threatened grassland fauna species).

Funding to support ongoing implementation of this Plan is also a key gap.

14. LEGAL FRAMEWORK

Emergency management

The *Victorian Emergency Management* (EM) *Act 2013* establishes Victoria's emergency management framework. The State Emergency Management Plan (SEMP) is authorised through the EM Act which contains provisions providing for the mitigation of, response to and recovery from emergencies, and specifies the roles and responsibilities of agencies in relation to emergency management.

EM Act: https://www.legislation.vic.gov.au/in-force/acts/emergency-management-act-2013/021

SEMP: https://www.emv.vic.gov.au/responsibilities/state-emergency-management-plan-semp

Workplace Health and Safety

The Goulburn Broken CMA Occupational Health and Safety (OHS) Policy details the organisations commitment to provide a safe and healthy workplace, consistent with its obligations under relevant state and national OHS legislation. The objectives of the policy are to ensure:

- All hazards and risks to health, safety and wellbeing including mental health are identified, assessed and where they cannot be eliminated are effectively controlled.
- Measures to control hazards and risks to health, safety and wellbeing are regularly monitored and evaluated.
- Employees are consulted and encouraged to contribute to the decision-making process on OHS matters affecting their health, safety, mental health, and general wellbeing at work.
- All employees receive the appropriate information, instruction, training, and supervision they need to safely carry out their responsibilities.
- GB CMA Board and Officers are provided with information and documentation that assists in meeting their responsibilities as directors of the Authority.

The Policy relates to the Goulburn Broken Employee OHS Integrated Procedure Manual, which details the general and specific OHS responsibilities applicable to the various levels within the organisation. It is intended as a guide to maintaining a safe and healthy working environment for all employees, contractors, volunteers, and visitors of the Goulburn Broken CMA.

15. RISK MANAGEMENT INCLUDING MITIGATION STRATEGIES

The tables below outline the key overarching risks associated with implementation of preparedness, response and recovery actions for biodiversity and agricultural natural capital assets, and risk mitigation actions.

Ratings for the likelihood, consequence and overall risk were assigned using the Goulburn Broken CMA's Risk Management Framework.

Consequence / Likelihood	1 - Insignificant	2 - Minor	3 - Moderate	4 - Major	5 - Extreme
1 – Rare	Low	Low	Low	Low	Significant
2 – Unlikely	Low	Low	Low	Moderate	Significant
3 – Possible	Low	Low	Moderate	Significant	High
4 – Likely	Low	Moderate	Significant	High	High
5 – Almost Certain	Moderate	Significant	High	High	Intolerable

Risk rating including likelihood, consequence, mitigation options and residual risk

Risk	Likelihood	Consequence	Risk Rating	Risk mitigation action	Residual risk
The health, safety and wellbeing of employees or contractors is impacted by their role in responding to an emergency event.	Possible	Extreme	High	The philosophy of protecting life and property will take precedence. Emergency services training and accreditation pathways are implemented. This Plan does not take the place of existing emergency response planning.	Moderate
Unintended ecosystem destruction occurs because of emergency response actions.	Possible	Moderate	Moderate	Preparedness Plan is provided to emergency service agencies for use in incident control centres, however, does not take the place of existing Plans.	Low
Resources are not available to implement this Plan.	Possible	Moderate	Moderate	National, State and Regional organisation continue to	Low.

Risk	Likelihood	Consequence	Risk Rating	Risk mitigation action	Residual risk
				advocate for implementation/ funding of the Plan.	
Emergency services organisations are not aware of this Plan.	Possible	Moderate	Moderate	Goulburn Broken CMA participates in Regional and Municipal Emergency Management Planning Committees. The Plan is socialised during its development.	Low
The Plan is not implemented by emergency services organisations.	Possible	Moderate	Moderate	National, State and Regional organisation continue to advocate for implementation / funding of the Plan.	Low

16. MONITORING AND DATA

This section outlines the nature of data collected or used as part of this Plan and how it will be accessed, shared, analysed, and stored in the Goulburn Broken catchment and accessible to the Australian Government.

Appropriate recording and storage of all documentation related to emergency management is essential and ensures:

- Ability to find relevant information (including in a new emergency), and
- Availability of documentation in a timely and logical manner for any review or investigation.

Maps of the locations of biodiversity assets

Threatened species - locations

Locations inhabited by threatened species are key information informing where preparedness, response and recovery actions should occur.

Maps in this Plan

This Plan includes maps showing where priority threatened species in the Goulburn Broken catchment have been observed and recorded based on records in the Victorian Biodiversity Atlas (VBA) (Appendix 1).

VBA threatened species records included in this Plan are based on the most recent version of VBA data available when the maps were developed, dated December 2023. A small number of threatened species maps include locations where Goulburn Broken CMA and stakeholders have recorded species, but records are not yet available in the VBA.

Maps included in this Plan provide an indication of species locations but are current at the time of data collection.

Victorian Biodiversity Atlas - data source, accessibility, and availability

The VBA is the primary data source for flora and fauna sightings including threatened species across Victoria for the full period of record. Anyone observing a threatened species can submit their observations and have them uploaded to the atlas once verified by DEECA administrators.

Organisations implementing this Plan and undertaking emergency preparedness, response, and recovery activities can access and view VBA species locations, which are publicly available online:

- VBA: https://www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas.
- DEECA's Naturekit Victoria mapping tool: https://www.environment.vic.gov.au/biodiversity/naturekit.
- The data can be downloaded from: https://www.data.vic.gov.au/.

These are the preferred sources of species observations as they are the most up-to-date and are user-friendly and fit for purpose.

VBA data is also available on eMap, a web-based platform that provides access to various mapping and data services for emergency, fire, resource, and water management in Victoria. eMap is annually updated and provides access to species records after the year 1980. Pre-1980 records are not available.

Some species locations are sensitive due to risks such as illegal poaching or removal and landholder privacy. The VBA's general level of access shows an approximate site location for sensitive records. Applications for access to sensitive data can be made by emailing vba.help@delwp.vic.gov.au. DEECA's VBA administrators consider

applications based on the type of data and the reason for the request. Accessing this data is important for emergency preparedness, response, and recovery to ensure threatened species locations are managed appropriately.

Habitat Distribution Models - data source, accessibility, and availability

Habitat distribution models predict and map where species are most likely to occur using the best scientific information available. The models are mathematical relationships between confirmed species locations and sets of environmental predictors that provide detailed information on climate, terrain, local productivity, vegetation structure, and other parameters.

Habitat distributions in this Plan are displayed based on the Australian Government's mapping of Species of National Environmental Significance Distributions. Distributions are produced by spatial ecologists in the Department using modelling software and environmental data to map the known and predicted areas of occurrence of EPBC Act listed species, including areas of potential habitat. The Department aims to update the data every six months.

The GIS data are coded as: 'Species or species habitat likely to occur' and 'Species or species habitat may occur'. A 'known to occur' category is not identified in the data and has been included in the 'Likely to occur' category.

This data can be downloaded from the Australian Government Department of Climate Change, Energy, the Environment and Water's 'Find Environmental Data' geoportal. In addition, habitat distributions can be viewed on the Protected Matters Search Tool: https://pmst.awe.gov.au/

The Arthur Rylah Institute and DEECA have also developed habitat distribution models for almost all of Victoria's terrestrial flora and fauna species, with published versions currently available for all listed rare and threatened species. Organisations implementing this Plan and undertaking emergency preparedness, response and recovery activities can access, view, and download these species habitat distribution models, which are publicly available online:

- DEECA's Naturekit Victoria mapping tool: https://www.environment.vic.gov.au/biodiversity/naturekit.

Maps showing both habitat distribution models and Victorian Biodiversity Atlas species observations can be viewed and downloaded on Naturekit, making it a valuable planning tool.

Threatened ecological communities - locations

Understanding the location of remnant patches of threatened ecological communities within the Goulburn Broken catchment is key to informing where preparedness, response, and recovery actions should occur.

Goulburn Broken CMA have prepared maps showing likely locations of threatened ecological communities for this Plan (Appendix 1). The maps include the following data:

- The Australian Government's mapping of Ecological Communities of National Environmental Significance Distributions 2020 mapping (DAWE 2021). This data can be downloaded from the Australian Government Department of Climate Change, Energy, the Environment and Water's 'Find Environmental Data' geoportal: https://www.environment.gov.au/fed/catalog/search/resource/details.page?uuid=%7B184A3793-2526-48F4-A268-5406A2BE85BC%7D.
- Mapping of Victorian Ecological Vegetation Classes (EVCs) considered to be likely equivalents to the EPBC-listed threatened ecological communities. This is consistent with EVCs identified in the Conservation Advice and National Recovery Plan for the ecological community (DSE 2005). This data can be downloaded from Victoria's DataVic open data platform: https://discover.data.vic.gov.au/dataset/native-vegetation-modelled-2005-ecological-vegetation-classes-with-bioregional-conservation-sta.

Ramsar sites – locations

The Barmah Ramsar Site is located in the north of the Goulburn Broken catchment. Figure 7 in Appendix 1 maps the location of the Ramsar site using the following data:

- The Australian Government's mapping of Ramsar Wetlands of Australia which shows the location and boundary of the Ramsar site. This data can be downloaded from the Australian Government Department of Climate Change, Energy, the Environment and Water's 'Find Environmental Data' geoportal: https://www.environment.gov.au/fed/catalog/search/resource/details.page?uuid=%7BF49BFC55-4306-4185-85A9-A5F8CD2380CF%7D.

Maps of the locations of agricultural natural capital assets

Goulburn Broken CMA mapped all agricultural natural capital assets using a single map based on the methodology and assumptions described here. The map can be viewed in Appendix 1, Figure 27.

The map is based on Victoria's Land Cover Time series (VLCTS) data for the time period 2015-2019. DEECA's website describes the VCTLS data as a visual and analytical snapshot of the current and previous type of land cover over different areas. That cover can include native forests, bushland, wetlands, farmland, land used for recreation, and built-up areas, including towns and cities (DEECA 2024).

Agricultural soil assets

Goulburn Broken CMA's mapping combines the six agricultural land uses from the VCLTS into a single category. This combines the following land use categories: Horticulture/irrigated pastures and crops, Dryland cropping, Exotic pasture/grassland, Hardwood plantation, Conifer plantation, Other exotic tree cover.

Riparian Areas, Native Vegetation, Agroforestry and Environmental Plantings on Farms

The mapping combines the VLCTS's seven natural environment land uses found in the Goulburn Broken catchment into a single category. This combines the following land use categories: Treed native vegetation, Scattered native trees, Native shrubland, Native pasture/grassland, Natural low cover, Wetland – perennial, Wetland – seasonal.

Water assets

The mapping shows the location of waterways in the Goulburn Broken catchment including major rivers, streams, and wetlands based on statewide hydrology layers available from Victoria's DataVic open data platform: https://www.data.vic.gov.au/

Rationale and assumptions

The Goulburn Broken CMA combined VLCTS categories to clearly map where agricultural natural capital assets occur based on the following assumptions:

- The risk to agricultural soils from natural disasters and catastrophic events like bushfire and flood are similar regardless of agricultural land use or production type. For example, the risk of soil erosion following removal of ground cover by bushfire is present irrespective of land use.
- The VLCTS clearly shows where native vegetation occurs in the landscape, including on agricultural properties. Data is not available to delineate between remnant patches of native vegetation, agroforestry, and environmental plantings on farms. Hence, combining the VLCTS's vegetation categories provides a proxy map of where these areas are likely to occur. The preparedness, response and recovery actions included in this Plan are similar across the different categories of vegetation on farms.

The VLCTS datasets can be accessed via the following links:

- Viewed on DEECA's Naturekit Victoria mapping tool: https://www.environment.vic.gov.au/biodiversity/naturekit.
- Downloaded from Victoria's DataVic open data platform: https://discover.data.vic.gov.au/dataset/victorian-land-cover-time-series.

The map is available in Appendix 1 (Figure 27) and spatial layers provided.

Maps of susceptibility to natural disasters and emergency events

The main natural disasters and emergency events included in this Plan are bushfire risk and flooding.

Bushfire risk

CMAs have worked with DEECA staff to deliver a bushfire risk assessment and maps for these Plans.

The fire behaviour simulations used to generate these maps were conducted using Phoenix RapidFire, a computerised bushfire model used by Victorian and other state fire agencies including DEECA and the Country Fire Authority (CFA) to model the behaviour of actual and potential fires. To look at potential bushfire impacts, fires are simulated across Victoria from ignitions within each cell of a 2km grid across the state.

Two maps are presented in this Plan:

- 'Intensity counts': this data represents the total number of ignitions impacting each cell. This measure can be used to provide a crude ranking of locations that are more 'hazardous' than others (Appendix 1, Figure 28).
- 'Intensity maximum': this data represents the worst modelled fireline intensity from any of the 70,000+ simulations used in the analysis, if using the worst-case fuel and weather scenario. This measure indicates the relative risk of severe (intense) bushfire and can be used as a 'worst-case' option for a conservative risk assessment (Appendix 1, Figure 29).

DEECA's Bushfire Risk, Engagement and Predictive Services team provided the information in Appendix 3 to accompany the maps included in this Plan.

Areas subject to flooding

The flood map shows the best estimate of the 1 in 100 annual exceedance probability (AEP) flood extent across the Goulburn Broken catchment. This layer was created by the Goulburn Broken CMA using a combination of flood modelling, historic flood extents and Planning Scheme Zones/Overlays (Appendix 1, Figure 30).

Flood investigations involve a detailed technical analysis of historic information to determine future flooding possibilities and their impacts. Community participation and ground-truthing are essential parts of investigations.

The flood map does not show stormwater or overland flooding that can occur because of rainfall events, because susceptibility or risk is not mapped for this parameter. All low-lying areas in the catchment are susceptible to localised flooding from rainfall events.

References

Adams, R, and D Simmons. 2000. *Survival, health and recruitment of Eucalyptus crenulata (Buxton Gum) - Base line data and monitoring guidelines.* Alexandra: Unpublished report to the Upper Goulburn Field Naturalists and the Department of Natural Resources and Environment, Funded under the Threatened Species Network Community Grant Scheme.

Ag Vic. 2023. *Goulburn Drought Resilience Plan.* Agriculture Victoria, Melbourne: Victorian Government.

ARMB. 2013. *Recovery Plan for the Mountain Pygmypossum Burramys parvus on Mount Buller, Victoria 2011 to 2016.* Mount Buller Mount Stirling Alpine Resort Management Board.

Belcher, C, A Borrell, I Davidson, and Webster, R. 2018. *Australasian Bittern Surveys in the Murray Valley and Barmah National Parks.* NSW National Parks and Wildlife Service, Office of Environment and Heritage, Sydney: New South Wales Government.

BirdLife Australia. 2024. *Australasian Bittern.* Accessed March 13, 2024. https://birdlife.org.au/bird-profiles/australasian-bittern/.

BirdLife Australia. 2024. *Swift Parrot.* Accessed February 5, 2024. https://birdlife.org.au/bird-profiles/swift-parrot.

Cheal, D., Lucas, A. and Macaulay, L. 2011. *National Recovery Plan for Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions.* Melbourne: Department of Sustainability and Environment.

Clemman, N, and G.R Gillespie. 2012. *National Recovery Plan for the Southern Bell Frog Litoria raniformis.* Department of Sustainability and Environment, Melbourne: Victorian Government.

Cornell, G, R Stoios, and J Lyon. 2023. *Water quality traffic lights for native fish .* Department of Energy, Environment and Climate Action, Arthur Rylah Institute for Environmental Research: Unpublished client report for Water and Catchments , Heidelberg: Victoria Government.

D Heinze, pers. comm. 2024. Dean Heinze, Ecologist, Ecology Links.

DAWE. 2021. *Ecological Communities of National Environmental Significance Distributions (public grids).* https://www.environment.gov.au/fed/catalog/search/resource/details.page?uuid=%7B184A3793-2526-48F4-A268-5406A2BE85BC%7D.

DAWE. 2021. *National Recovery Plan for the Grey-headed Flying-fox Pteropus poliocephalus.* Department of Agriculture, Water and the Environment, Canberra: Australian Government.

DAWE. 2021. *National Recovery Plan for the Superb Parrot (Polytelis swainsonii).* Department of Agriculture, Water and the Environment, Canberra: Australian Government.

DCCEEW. 2023. *Approved Conservation Advice for the Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions.* Department of Climate Change, Energy, the Environment and Water, Canberra: Australian Government.

DCCEEW. 2023. *Conservation Advice for the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.* Department of Climate Change, Energy, the Environment and Water, Canberra: Australian Government.

DCCEEW. 2022. *Draft National Recovery Plan for the Spiny Rice-flower (Pimelea spinescens subspecies spinescens) .* Department of Climate Change, Energy, the Environment and Water, Canberra: Australian Government.

DCCEEW. 2024. *National Flying-fox monitoring viewer.* Accessed March 7, 2024. https://www.environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf.

DCCEEW. 2024. *National Recovery Plan for Leadbeater's Possum (Gymnobelideus leadbeateri) .* Department of Climate Change, Energy, the Environment and Water, Canberra: Australian Government.

DCCEEW. 2022. *National Recovery Plan for the Australasian Bittern (Botaurus poiciloptilus).* Department of Climate Change, Energy, the Environment and Water, Canberra: Australian Government.

DCCEEW. 2024. *The impacts of bushfires on freshwater ecosystems: Summary of findings.* Department of Climate Change, Energy, the Environment and Water NSW, Sydney: New South Wales Government.

DECCW. 2010. *National Recovery Plan for White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland.* Department of Environment, Climate Change and Water, Sydney: New South Wales Government.

DEE. 2019. *Conservation Advice Botaurus poiciloptilus Australasian Bittern.* Department of the Environment and Energy, Threatened Species Scientific Committee, Canberra: Australian Government.

DEE. 2018. *Conservation Advice Burramys parvus mountain pygmy-possum.* Department of the Environment and Energy, Threatened Species Scientific Committee, Canberra: Australian Government.

DEECA. 2023. *Growling Grass Frog (Litoria raniformis) Action statement FFG Act 1988 Taxon ID: 13207.* Department of Energy, Environment and Climate Action, Melbourne: Victorian Government.

DEECA. 2024. *Rainforest Mapping for state-wide Victoria.* Accessed April 17, 2024. https://discover.data.vic.gov.au/dataset/rainforest-mapping-for-state-wide-victoria.

DEECA. 2023. *Round-leaf Pomaderris (Pomaderris vacciniifolia) Action statement FFG Act 1988 Taxon ID: 502675.* Department of Energy, Environment and Climate Action, Melbourne: Victorian Government.

DEECA. 2024. *Victoria's Land Cover Time Series.* 27 February. https://www.environment.vic.gov.au/biodiversity/Victorias-Land-Cover-Time-Series.

DELWP. 2020. *Gippsland Bushfire Management Strategy 2020.* Melbourne: The State of Victoria Department of Environment, Land, Water and Planning. Accessed April 29, 2024. https://www.safertogether.vic.gov.au/__data/assets/pdf_file/0028/493534/DELWP_BushfireManagementStrategies_2020_Gippsland_rr.pdf.

DELWP. 2020. *Hume Bushfire Management Strategy.* Department of Land, Water and Planning, Melbourne: Victorian Government.

DELWP. 2016. *National Recovery Plan for the Mountain Pygmy-possum Burramys parvus.* Prepared by the Victorian Government Department of Environment Land, Water and Planning, Canberra: Australian Government.

DEPI. 2012. *Alpine Bogs Recovery Plan mapping (unpublished).* Department of Environment and Primary Industries, Melbourne: Victorian Government.

DEPI. 2014. *Leadbeater's Possum Gymnobelideus leadbeateri FFG Act 1988 Action Statement No. 62.* Department of Environment and Primary Industries, Melbourne: Victorian Government.

DEWHA. 2009. *Alpine Sphagnum Bogs and Associated Fens: EPBC Act 1999 Policy Statement 3.16.* Department of Environment, Water, Heritage and the Arts, Canberra: Australian Government.

DEWHA. 2008. *Approved Conservation Advice for the Alpine Sphagnum Bogs and Associated Fens ecological community.* Department of Environment, Water, Heritage and the Arts, Canberra: Australian Government.

DEWHA. 2010. *Approved Conservation Advice for the Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-east Australia.* Department of the Environment, Water, Heritage and the Arts, Canberra: Australian Government.

DEWHA. 2010. *Listing Advice for Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia.* Department of Environment, Water, Heritage and the Arts, Canberra: Australian Government.

DoE. 2014. *Approved Conservation Advice for Pomaderris vacciniifolia (round-leaf pomaderris).* Department of the Environment, Canberra: Australian Government.

DoE. 2015. *National recovery plan for the Alpine Sphagnum Bogs and Associated Fens ecological community.* Department of the Environment, Canberra: Australian Government.

DoE. 2016. *National Recovery Plan for the Regent Honeyeater (Anthochaera phrygia).* Department of the Environment, Canberra: Australian Government.

DSE. 2006. *Box – Gum Grassy Woodlands and Derived Grasslands: A nationally threatened vegetation community found in the Goulburn Broken.* Department of Sustainability and Environment, Melbourne: Victorian Government.

DSE. 2006. *Grey Box-Buloke Grassy Woodlands: A nationally threatened vegetation community found in the Goulburn Broken.* Department of Sustainability and Environment, Melbourne: Victorian Government.

DSE. 2005. *Native Vegetation - Modelled 2005 Ecological Vegetation Classes (with Bioregional Conservation Status).* Melbourne. https://discover.data.vic.gov.au/dataset/native-vegetation-modelled-2005-ecological-vegetation-classes-with-bioregional-conservation-sta.

DSE. 2006. *Northern Plains Grassland: A nationally threatened vegetation community in the Goulburn Broken.* Department of Sustainability and Environment, Melbourne: Victorian Government.

DSE. 2005. *Spiny Rice-flower Pimelea spinescens subsp. spinescens Rye.: Habitat condition and demographic structure of 16 selected populations from The Victorian Riverina and Volcanic Plains.* Department of Sustainability and Environment, Report No:1, Spiny Rice-flower Recovery Plan Working Group, Melbourne: Victorian Government.

DSE. 2008. *Spiny Rice-flower Pimelea spinescens subsp. spinescens Action Statement FFG Act 1988 No. 132 (Revised in 2008) .* Department of Sustainability and Environment, Melbourne: Victorian Government.

DSEWPC. 2012. *Approved Conservation Advice for Natural Grasslands of the Murray Valley Plains ecological community.* Department of Sustainability, Environment, Water, Population and Communities, Canberra: Australian Government.

DSEWPC. 2012. *Approved Conservation Advice for the Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains.* Department of Sustainability, Environment, Water, Population and Communities, Canberra: Australian Government.

DSEWPC. 2012. *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia: A guide to the identification, assessment and management of a nationally threatened ecological community.* Department of Sustainability, Environment, Water, Population and Communities, Canberra: Australian Government.

EMV. 2023. *Victorian State Emergency Management Plan.* Emergency Management Victoria, Victorian Government.

GB CMA. 2014. *Goulburn Broken Waterway Strategy 2014-2022.* Shepparton: Goulburn Broken Catchment Management Authority.

GB CMA. 2024. *Land.* Goulburn Broken Catchment Management Authority. 1 March. https://goulburnbroken.rcs.vic.gov.au.

GB CMA. 2024. *Shepparton Irrigation Region Land and Water Management Plan 2050 (Draft).* Shepparton: Goulburn Broken Catchment Management Authority.

Gillespie, G, and P Robertson. 1998. *Spotted Tree Frog 1998-2002 Recovery Plan.* Department of Natural Resources and Environment, Report to Environment Australia, Canberra: Australian Government.

Hale, J, and R Butcher. 2011. *Ecological Character Description for the Barmah Forest Ramsar Site.* Report to the Department of Sustainability, Environment, Water, Population and Communities, Canberra: Australian Government.

Hansby, M, L Riches, M Nurse, and Taungurung Nation Forest and Fire Knowledge Circle. 2023. *Rapid Biocultural Expressions Assessment of the State Forests within the Central Highlands Regional Forest Agreement (CHRFA) area occurring on Taungurung Country.* Cultural Land Management Division, Taungurung Country: Taungurung Land and Waters Council.

Howell, M, and R McLennan. 2002. *Wetlands direction paper for the Goulburn Broken Catchment.* Shepparton: Goulburn Broken Catchment Management Authority.

J Mentiplay-Smith, pers. comm. 2024. Janice Mentiplay-Smith, Land and Biodiversity Project Officer, GB CMA, 20 February.

J Whittaker pers. comm. 2024. Jay Whittaker, Whole of Country Manager, Yorta Yorta Nation Aboriginal Corporation , 10 April.

Lumsden, L.F., J.L. Nelson, M.P. Scroggie, E.G. McNabb, T.A. Raadik, S.J. Smith, C.R. Todd, et al. 2013. *A New Strategic Approach to Biodiversity Management - Research Component.* Department of Sustainability and Environment, Arthur Rylah Institute for Environmental Research: Unpublished Client Report for the Department of Primary Industries, Heidelberg: Victorian Government.

McMahon, A, Tolsma, A, J McMahon, F Coates, and R Lawrence. 2015. *Victorian Alpine Peatlands Spatial Action Plan: A framework for managing Victoria's peatlands.* Melbourne: Ecology Australia Pty Ltd.

Mowat, E, B Meney, K Peters, C Timewell, D Ingwersen, and M Roderick. 2021. *Saving the Swift Parrot: A Conservation and Management Guide.* Melbourne: BirdLife Australia.

Murphy, A.H, and J Downe. 2006.
National Recovery Plan for the Lima Stringybark Eucalyptus alligatrix subspecies limaensis. Department of Sustainability and Environment, Melbourne: Victorian Government.

Nevill, G.R, and M Camilleri. 2010. *National Recovery Plan for the Stiff Groundsel Senecio behrianus.* Department of Sustainability and Environment, Melbourne: Victorian Government.

Nillumbik Shire Council. 2024. *Round-leaf Pomaderris.* Accessed February 10, 2014. https://www.nillumbik.vic.gov.au/Explore/Environment/Natural-environment/Animals/Native-animals/Round-leaf-Pomaderris.

Papas, P, M White, B Cant, P Griffioen, D Crowther, and D Cook. 2016. *Predicting the occurrence of seasonal herbaceous wetlands in south-east Australia. Arthur Rylah Institute for Environmental Research. Technical Report Series No.271.* Technical Report, Department of Environment, Land, Water and Planning, Heidelberg: Victorian State Government.

Parks Victoria. 2024. *Fire and emergency planning, prevention, response and recovery.* 21 February. https://www.parks.vic.gov.au/get-into-nature/conservation-and-science/science-and-research/state-of-the-parks/fire-and-emergency-management/fire-and-emergency-planning-prevention-response-and-recovery#:~:text=Parks%20Victoria%20has%20a%20crucial%20role%20.

R Caldwell, pers. comm. 2024. Rebecca Caldwell, Land and Biodiversity Manager, GB CMA.

REMPC. 2023. *Hume Region Regional Emergency Management Plan.* Hume Regional Emergency Management Planning Committee, Emergency Management Victoria.

Saunders, D L, and C L Tzaros. 2011. *National Recovery Plan for the Swift Parrot (Lathamus discolor).* Melbourne: Birds Australia.

White, M, A.H Murphy, and J Downe. 2006. *National Recovery Plan for the Buxton Gum Eucalyptus crenulata.* Department of Sustainability and Environment, Melbourne: Victorian Government.

Winton Wetlands Committee of Management. 2023. *Growling Grass Frogs - Population status in northern VIctoria.* Accessed February 21, 2024. https://wintonwetlands.org.au/growling-grass-frogs/population-status-in-northern-victoria/.

Zoos Victoria. 2024. *Spotted Tree Frog.* Accessed March 13, 2024. https://www.zoo.org.au/fighting-extinction/local-threatened-species/spotted-tree-frog/.

Milestone 3a. Deliverable 1.

Appendix 1. Mapping of biodiversity assets, agricultural natural capital assets, and susceptibility to emergency events.

This document addresses Milestone 3a, Deliverable 1 of the Work Order by providing complete mapping of biodiversity and agricultural natural capital assets at an appropriate scale for emergency response, meeting the standards outlined in the *On-Ground Investment Location Data Capture, Management and Sharing Standards V1.0*.

Biodiversity assets

Threatened Ecological Communities

Six nationally threatened ecological communities occur within the Goulburn Broken catchment (Table 1). Maps have been prepared to show the likely distribution and priority locations of these communities within the catchment.

Table 1 Nationally threatened ecological communities occurring within the Goulburn Broken catchment

Threatened ecological community	***Environment Protection and Biodiversity Conservation Act* (1999) status**	**Figure and page number**
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	Critically Endangered	Figure 1, Page 2
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Figure 2, Page 3
Natural Grasslands of the Murray Valley Plains	Critically Endangered	Figure 3, Page 4
Alpine Sphagnum Bogs and Associated Fens	Endangered	Figure 4, Page 5
Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Figure 5, Page 6
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregion	Endangered	Figure 6, Page 7

Maps were prepared using the following publicly available data:

- The Australian Government's mapping of Ecological Communities of National Environmental Significance Distributions (DAWE 2022), downloaded from the Australian Government Department of Climate Change, Energy, the Environment and Water's 'Find Environmental Data' geoportal.
- The Victorian government's mapping of Victorian Ecological Vegetation Classes (EVCs) considered to be likely equivalents to the EPBC-listed threatened ecological communities, downloaded from Victoria's DataVic platform (DSE 2005). Where equivalent EVCs are identified within the Conservation Advice and National Recovery Plan for the ecological community, those EVCs have been included. Where EVCs are not identified in official conservation advice, equivalent or closely related EVCs were identified through consultation with experts.

Where additional data were available, e.g. modelled or ground-truthed mapping, these were included for relevant communities.

Figure 1Map of the estimated distribution of ***Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains*** *within the Goulburn Broken catchment.*

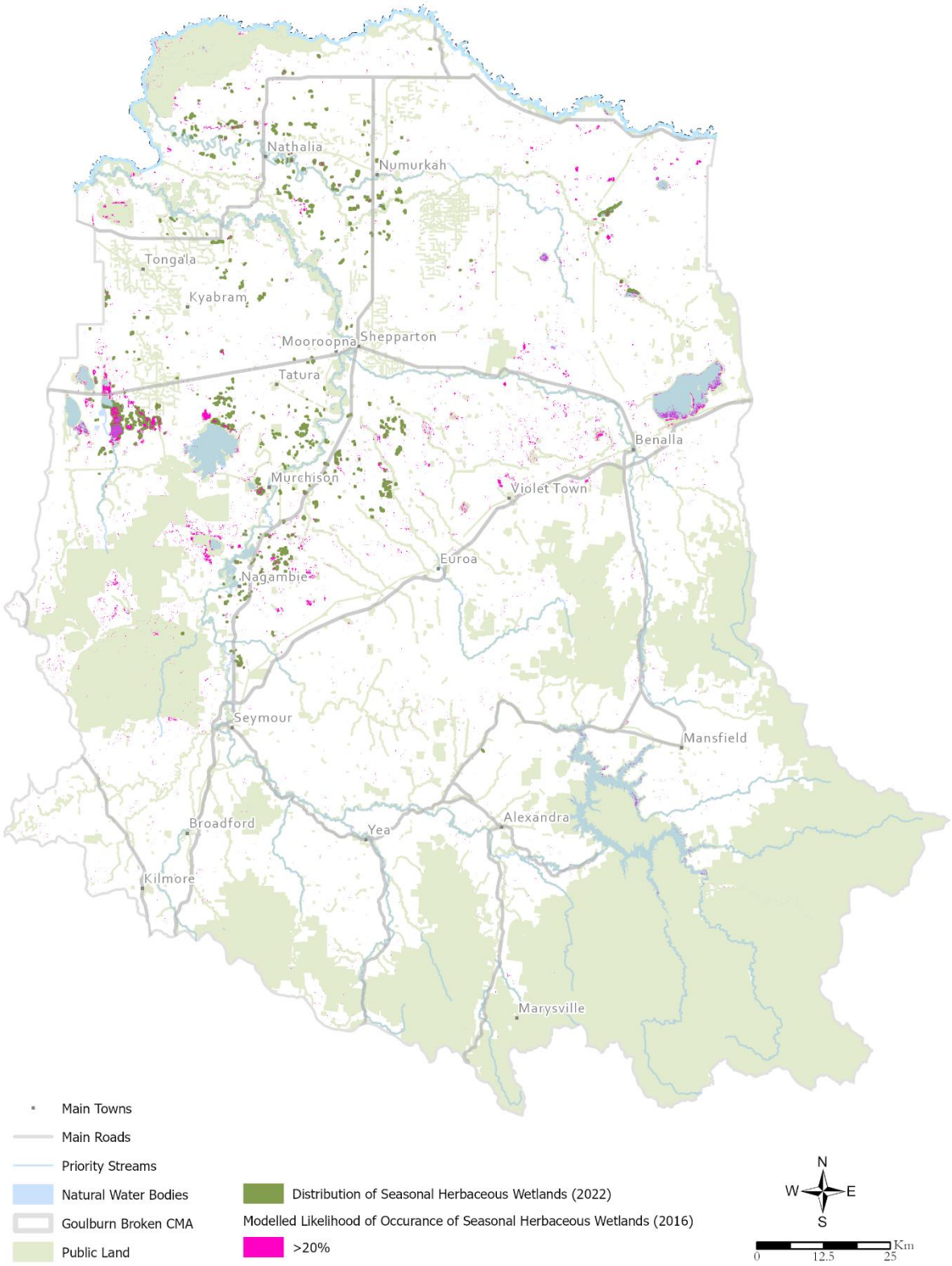


Figure 2 Map of the estimated distribution of ***White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland*** *within the Goulburn Broken catchment.*

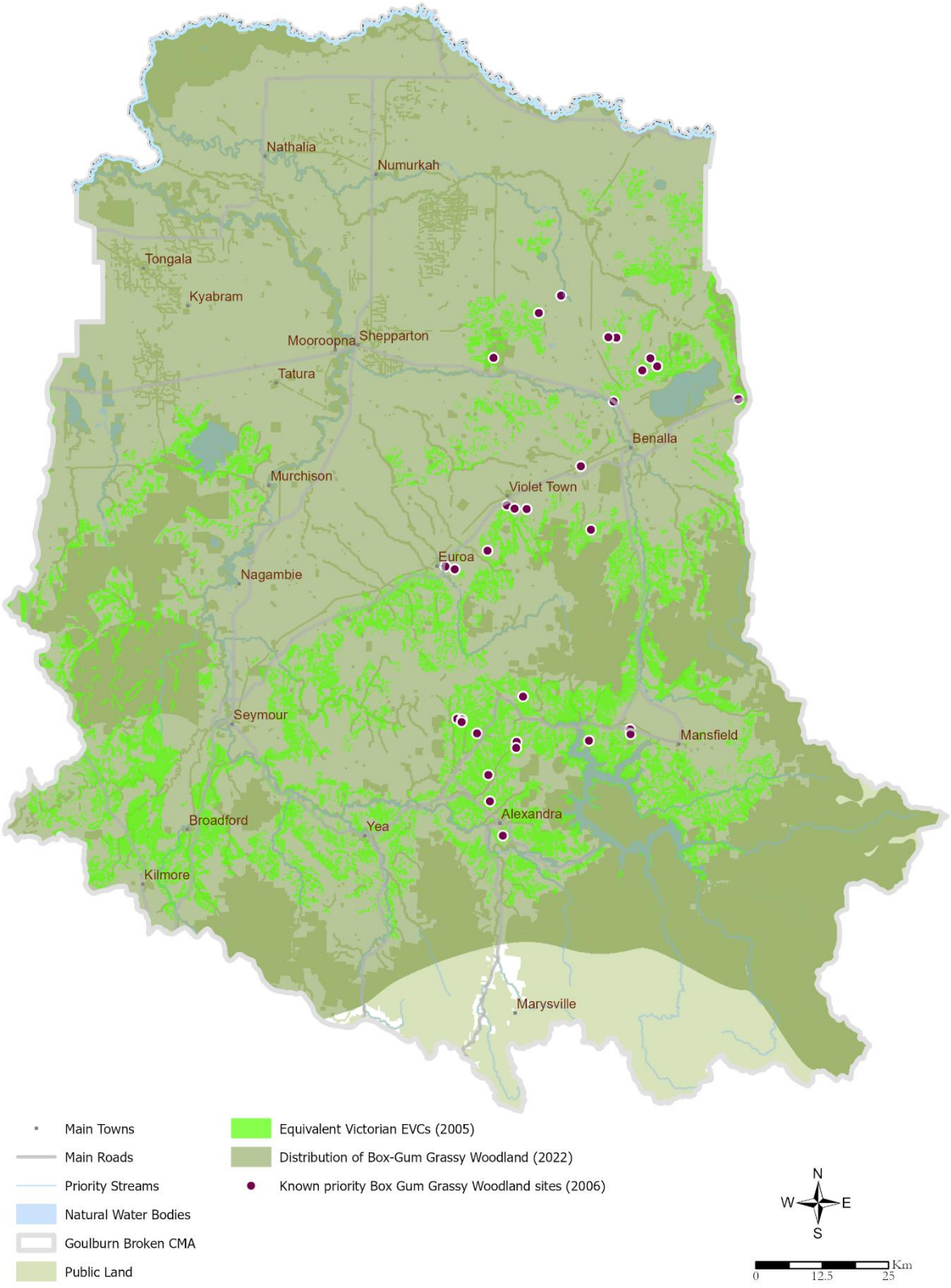


*Figure 3 Map of the estimated distribution of **Natural Grasslands of the Murray Valley Plains** within the Goulburn Broken catchment.*

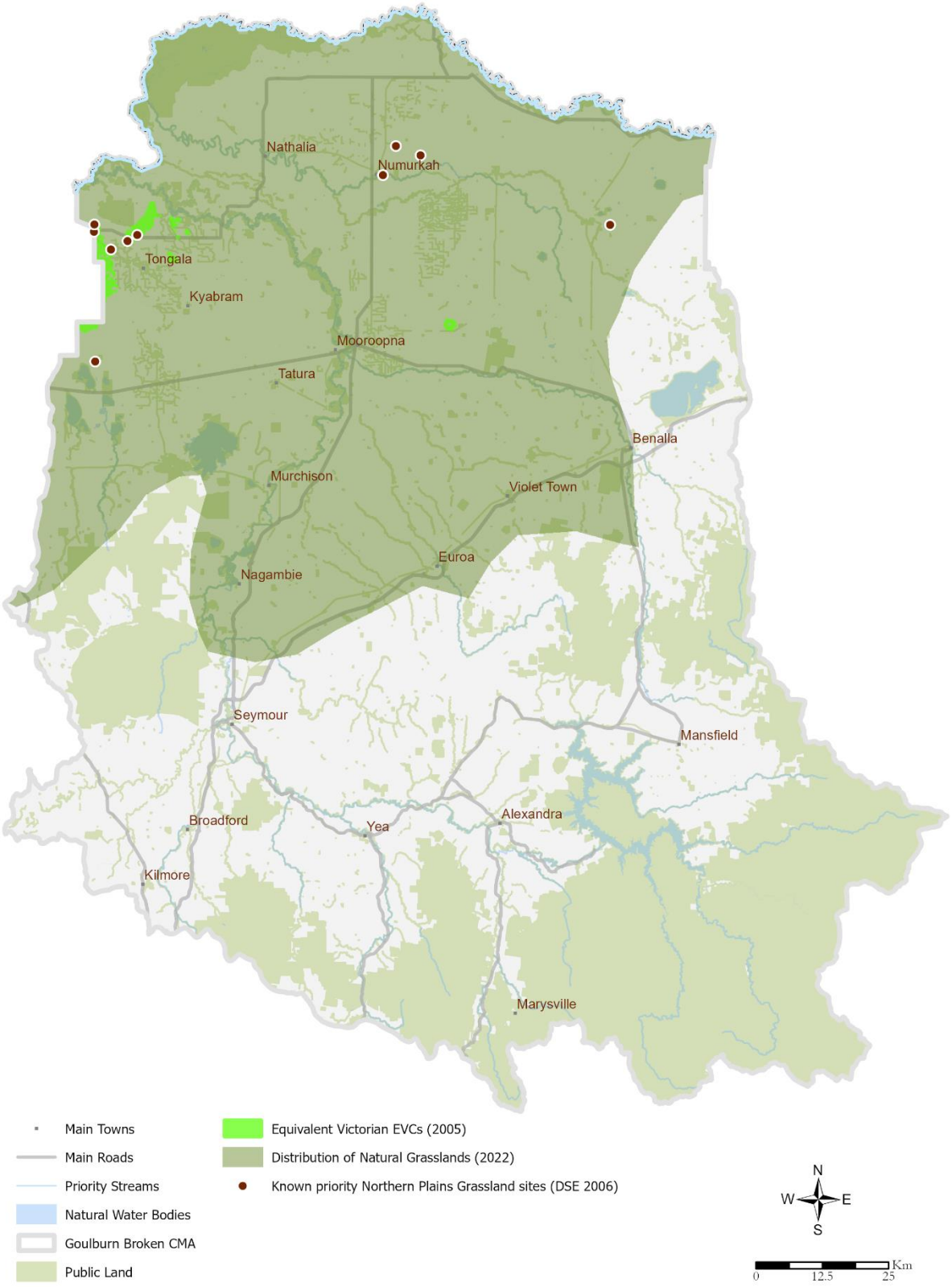


*Figure 4 Map of the estimated distribution of **Alpine Sphagnum Bogs and Associated Fens** (and closely associated threatened species) within the Goulburn Broken catchment.*

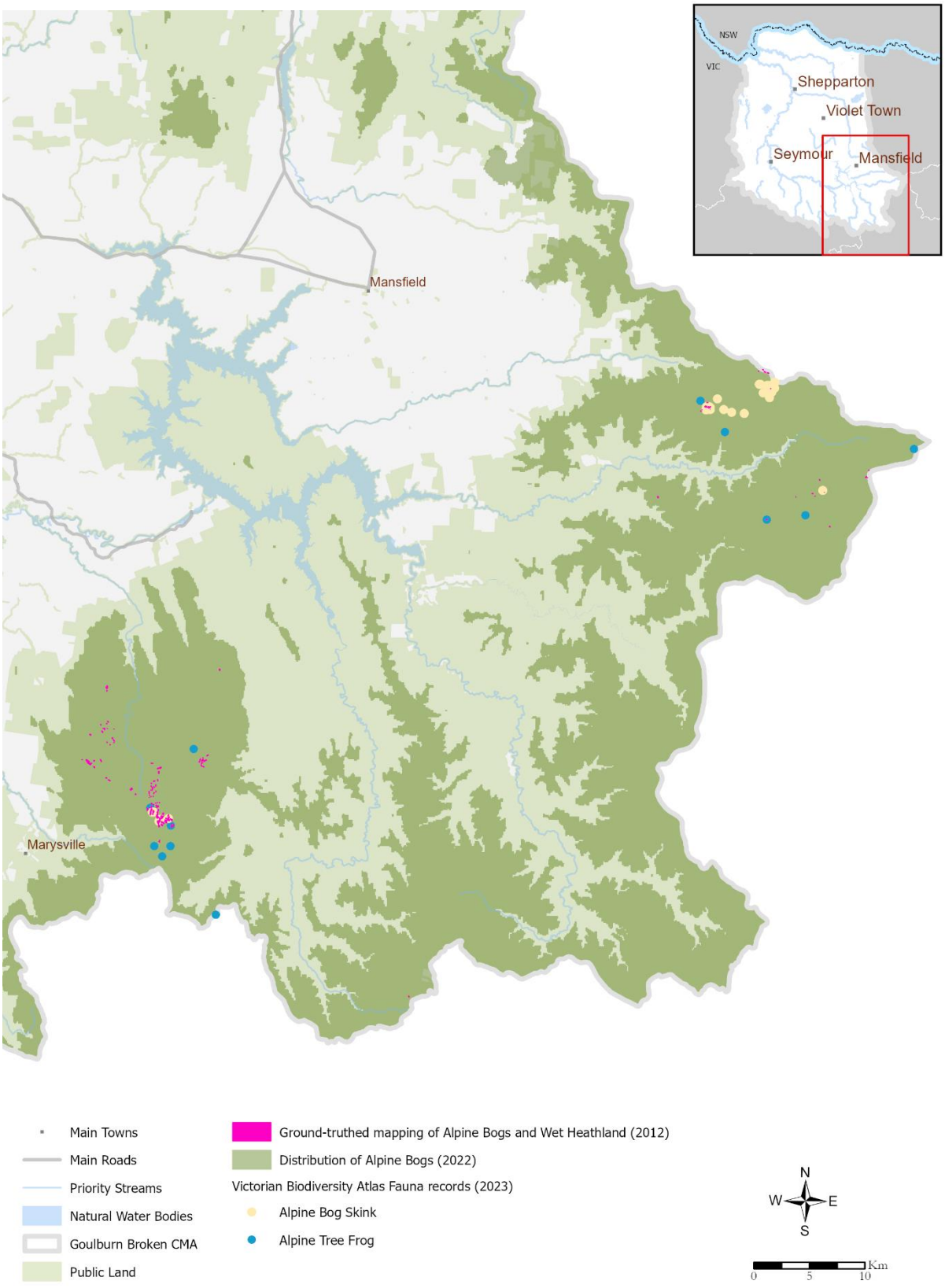


Figure 5 Map of the estimated distribution of ***Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia*** *within the Goulburn Broken catchment.*

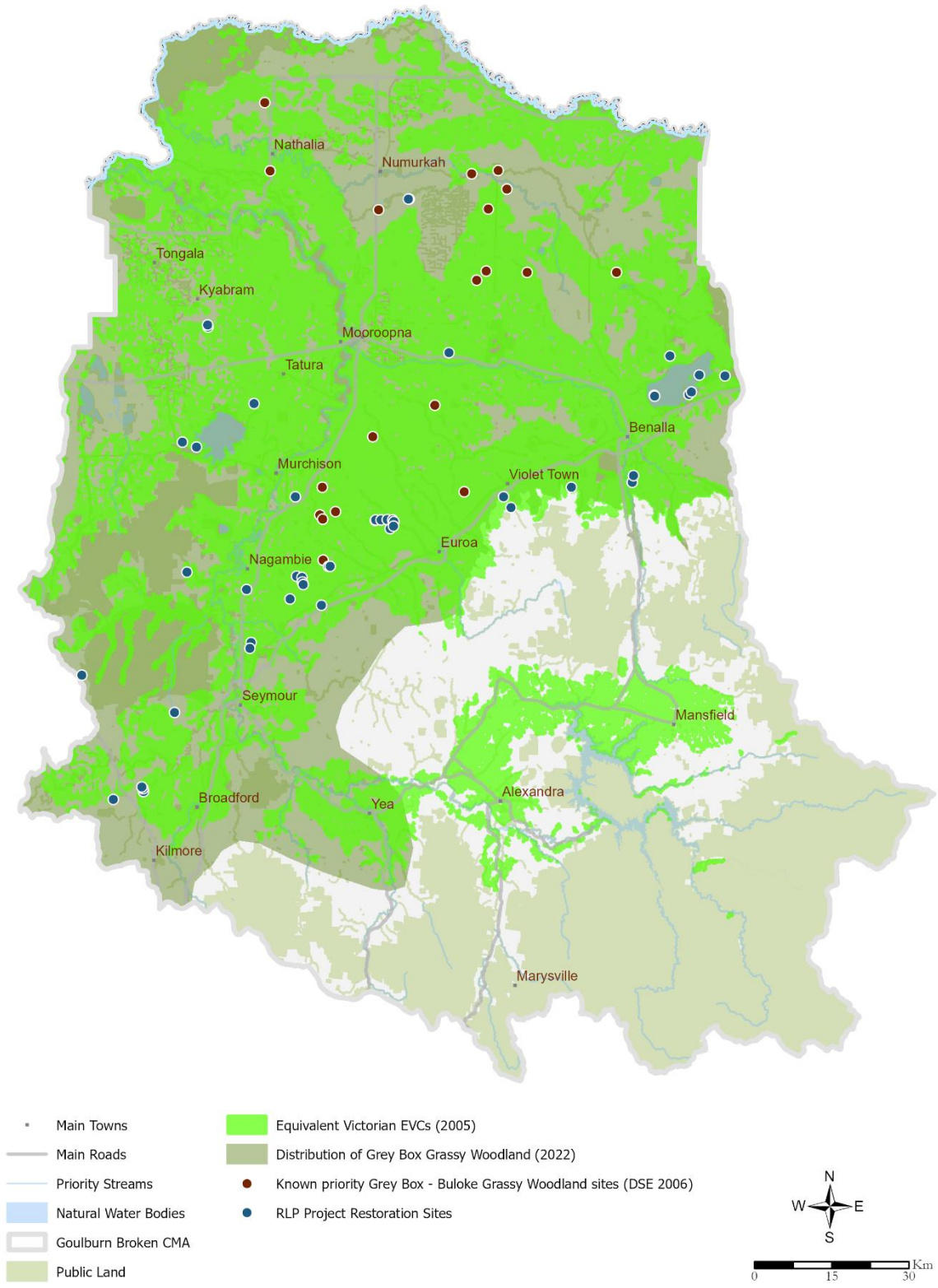
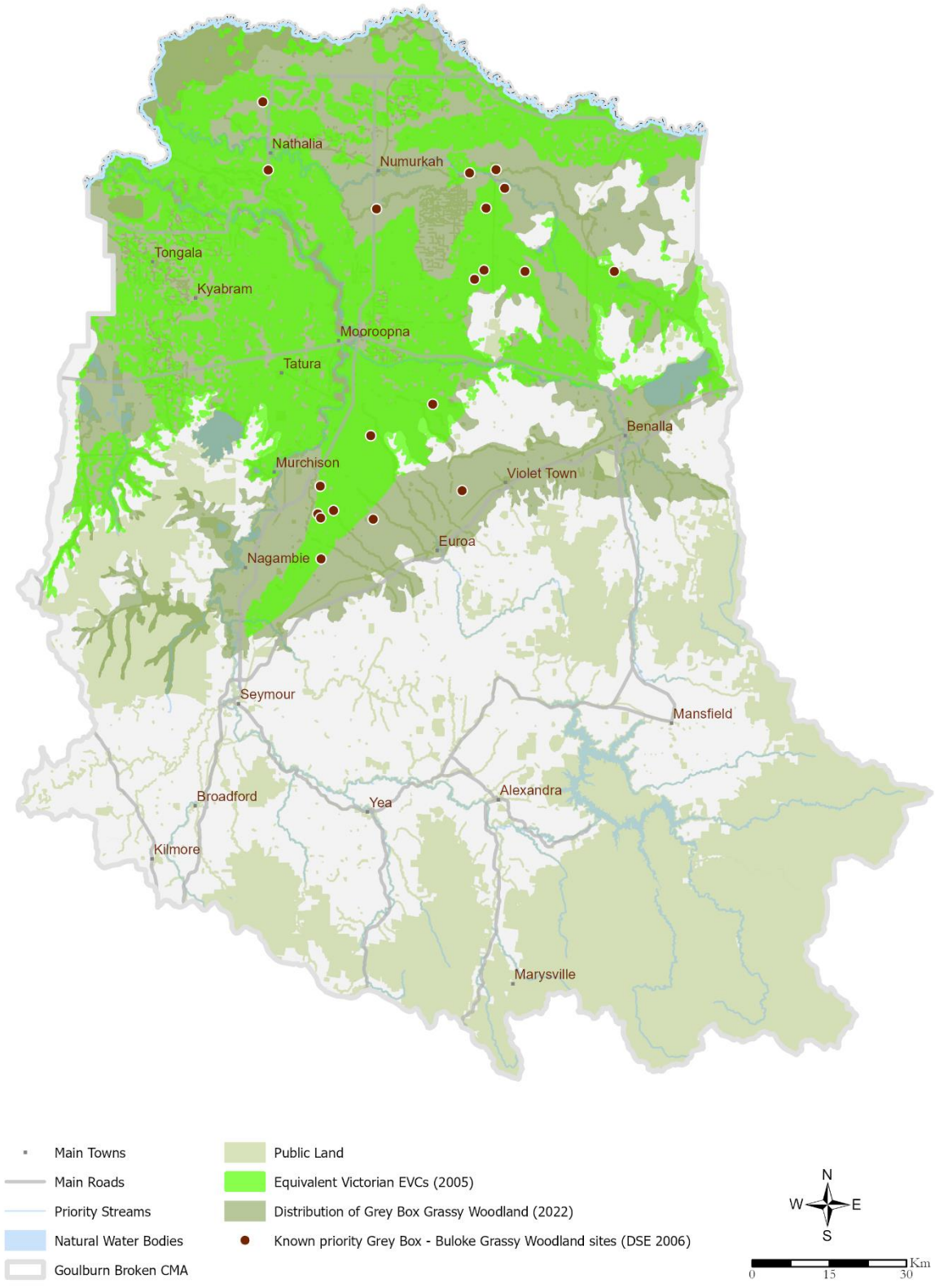


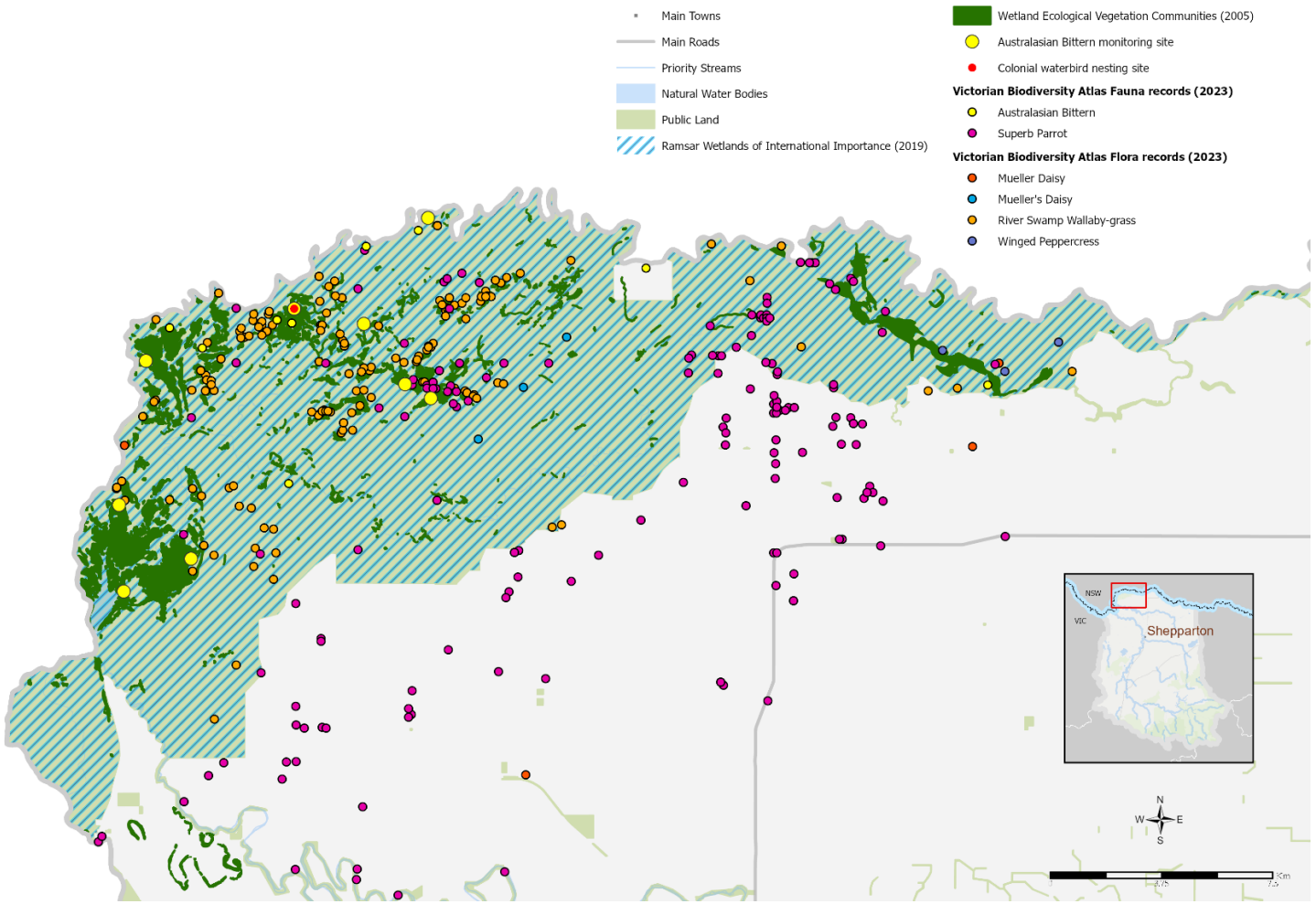
Figure 6 Map of the estimated distribution of ***Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregion*** *within the Goulburn Broken catchment.*



Barmah Forest Ramsar Site

The sole Ramsar site within the Goulburn Broken catchment is the Barmah Forest Ramsar site. The location and boundary of the Ramsar site have been mapped using the Australian Government's mapping of Ramsar Wetlands of Australia, downloaded from the Australian Government Department of Climate Change, Energy, the Environment and Water's 'Find Environmental Data' geoportal.

*Figure 7 Location of the **Barmah Forest Ramsar site**.*



Threatened Species

This Plan includes maps showing where priority threatened species have been observed and recorded based on records in the Victorian Biodiversity Atlas (VBA). VBA threatened species records included in this Plan are based on the most recent version of VBA data available when the maps were developed, dated December 2023.

Where applicable, habitat distributions are also displayed based on the Australian Government's mapping of Species of National Environmental Significance Distributions (DCCEEW 2023).

Where additional data were available (e.g. known populations not yet recorded in the VBA, reintroduction sites, and key project sites), these were included alongside VBA records for relevant species.

*Figure 8 Map of estimated distribution of nationally **threatened fish species** within the Goulburn Broken catchment based on Victorian Biodiversity Atlas records.*

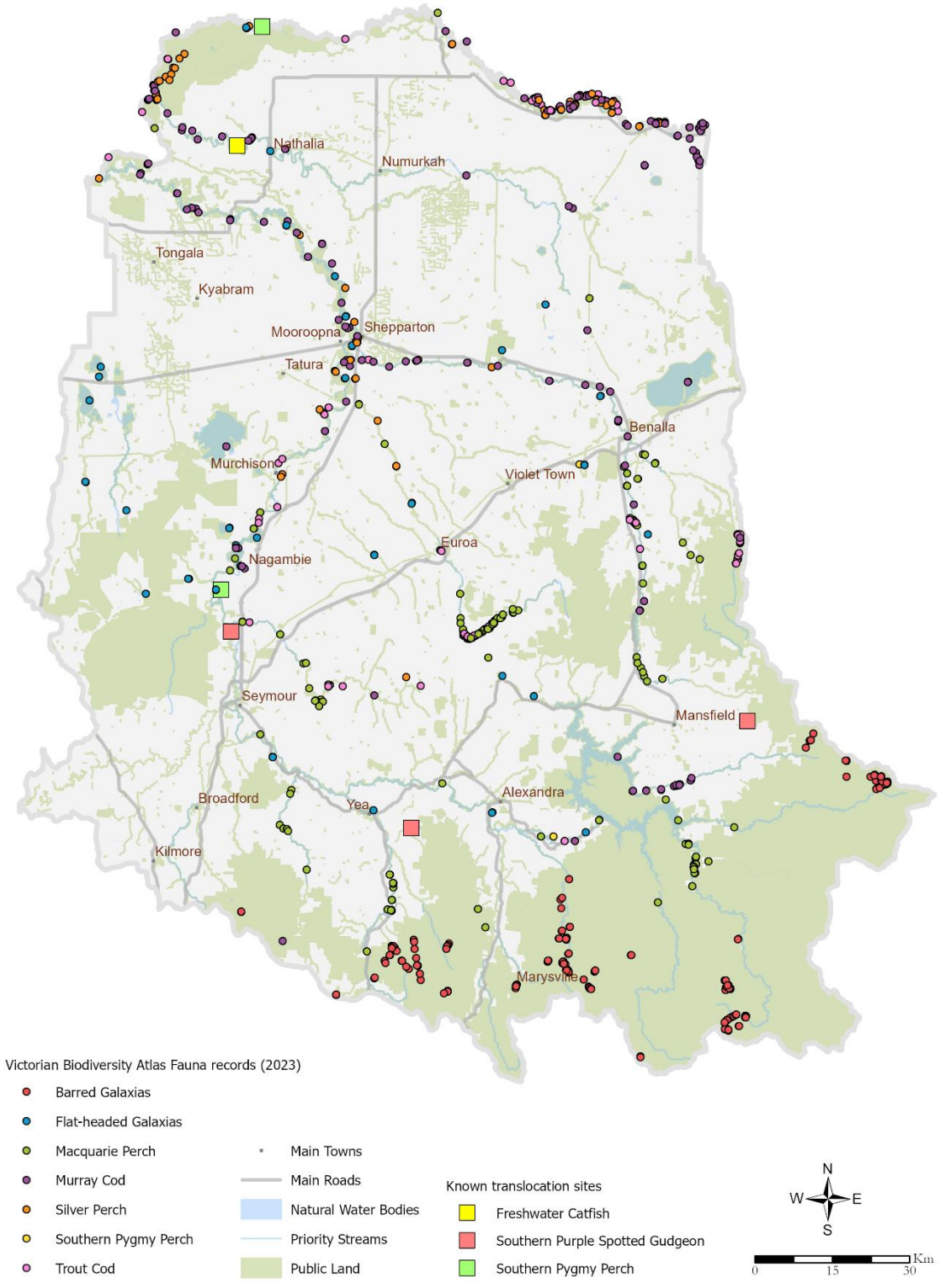


*Figure 9 Map of estimated distribution of **Swift Parrot (Lathamus discolor)** within the Goulburn Broken catchment based on Victorian Biodiversity Atlas records.*

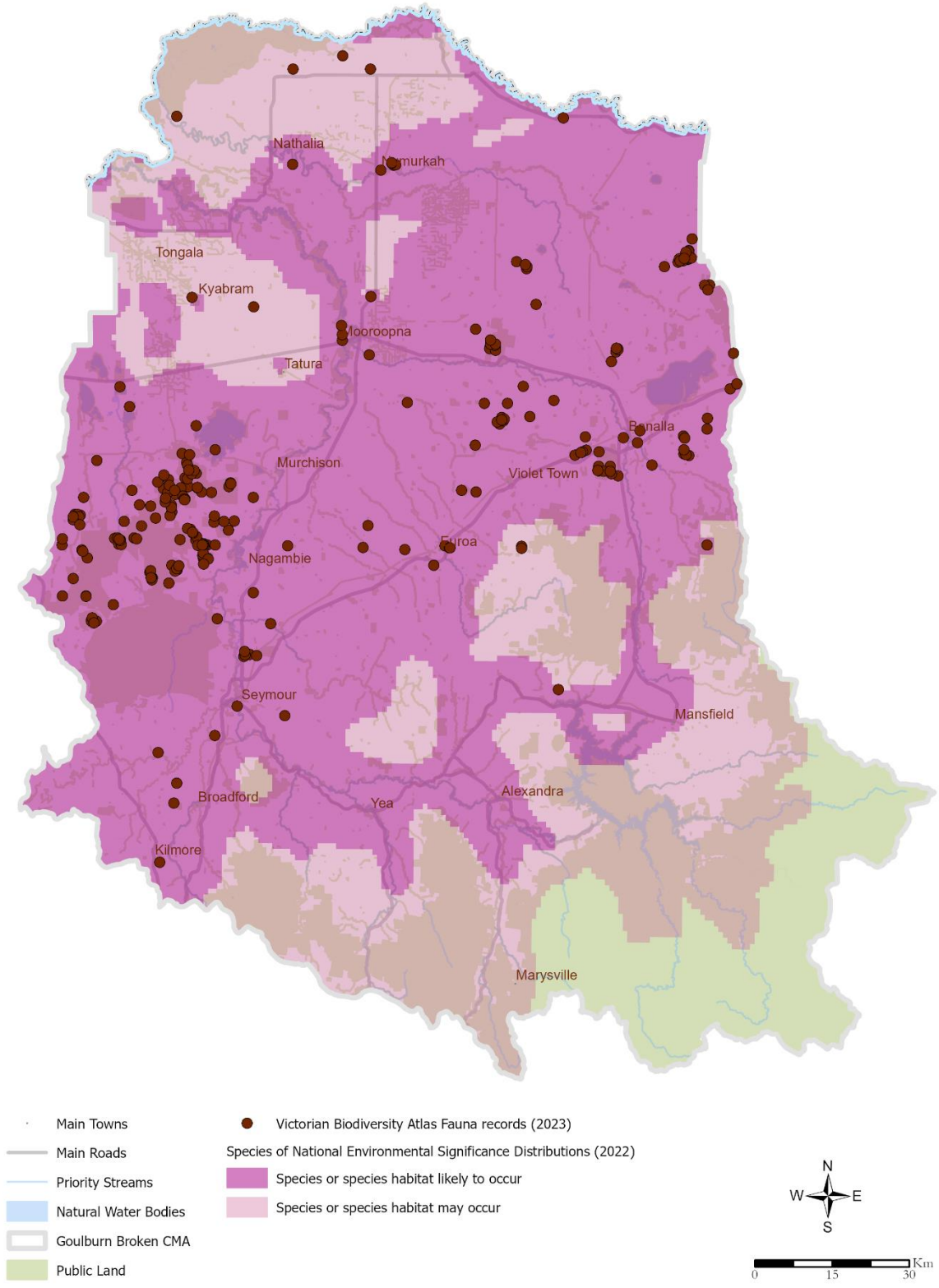


*Figure 10 Map of estimated distribution of **Regent Honeyeater (Anthochaera phrygia)** within the Goulburn Broken catchment based on Victorian Biodiversity Atlas records.*

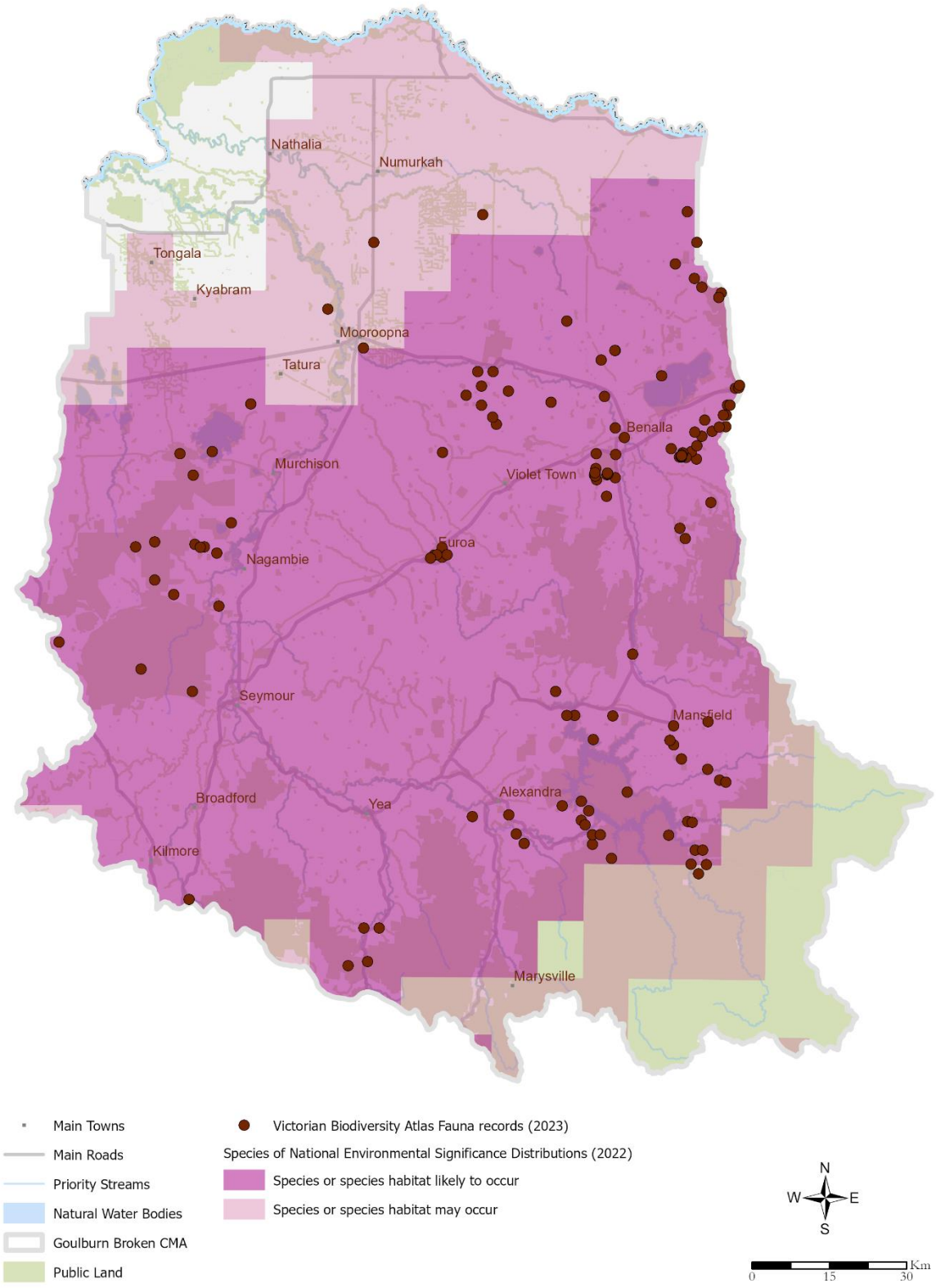


*Figure 11 Map of estimated distribution of **Leadbeater's Possum (Gymnobelideus leadbeateri)** within the Goulburn Broken catchment based on Victorian Biodiversity Atlas records.*

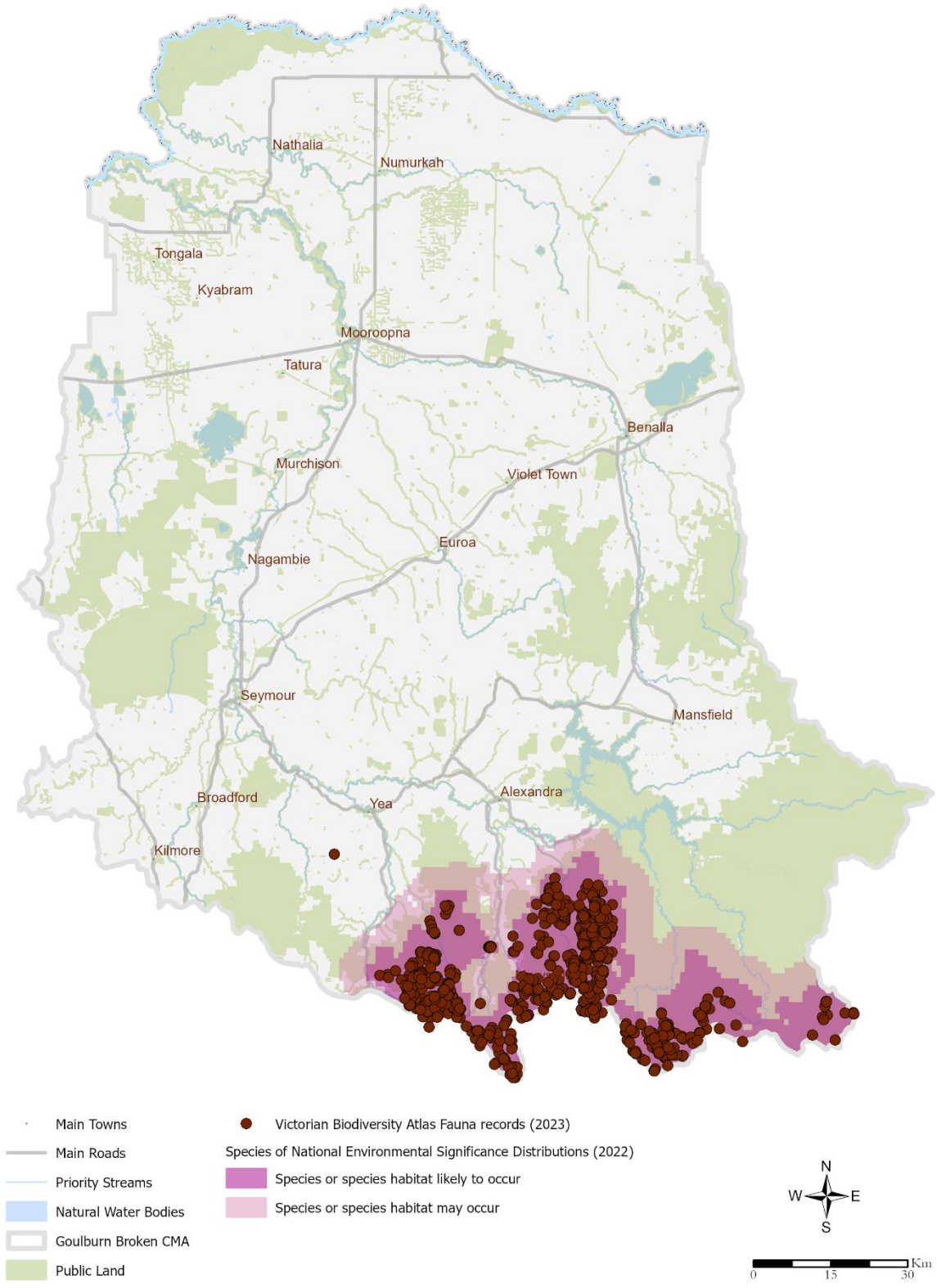


*Figure 12 Map of estimated distribution of **Spotted Tree Frog (Litoria spenceri)** within the Goulburn Broken catchment based on Victorian Biodiversity Atlas records.*

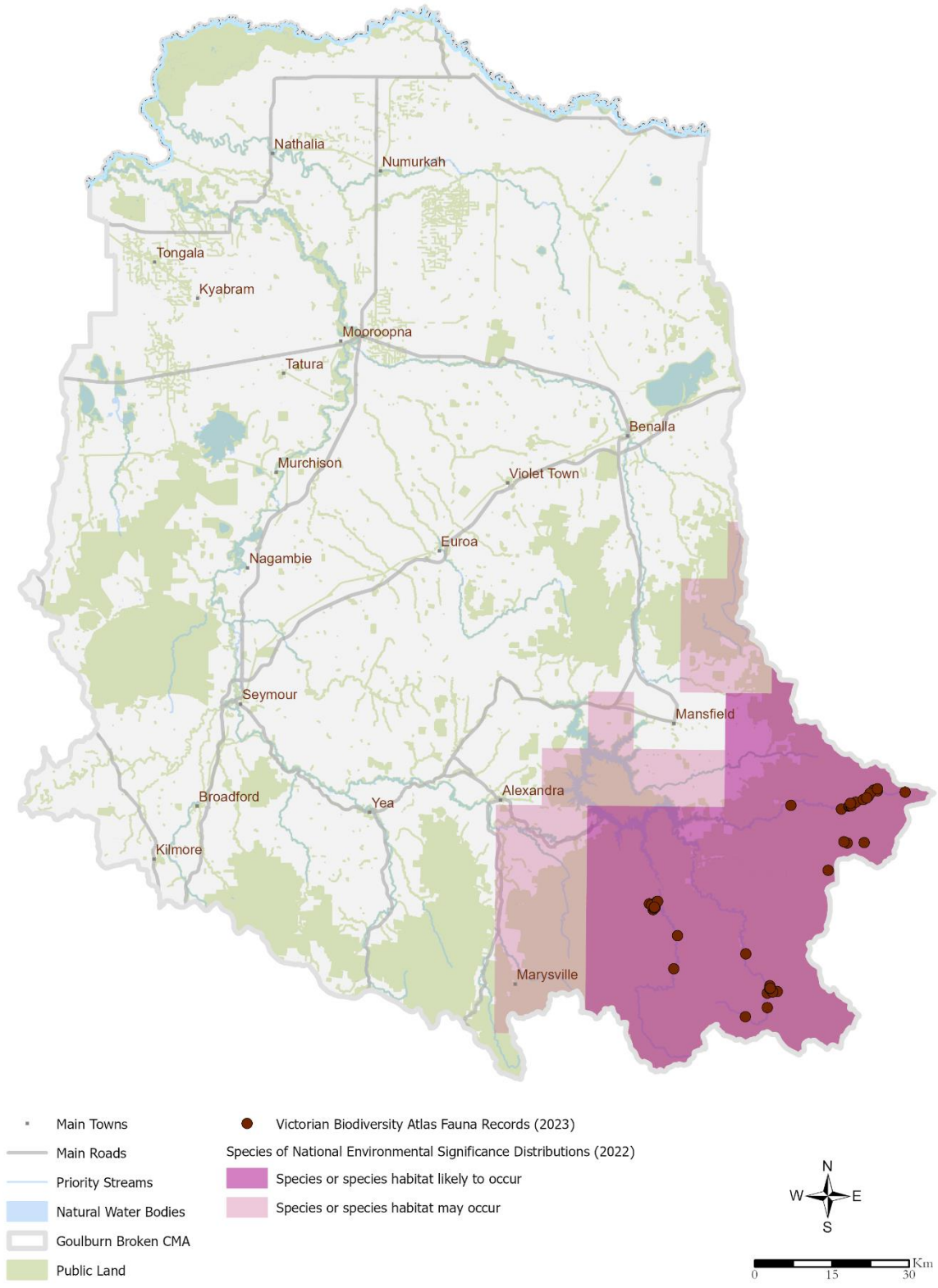


Figure 13 Map of estimated distribution of ***Round-leaf Pomaderris (Pomaderris vacciniifolia)*** *within the Goulburn Broken catchment based on Victorian Biodiversity Atlas records.*

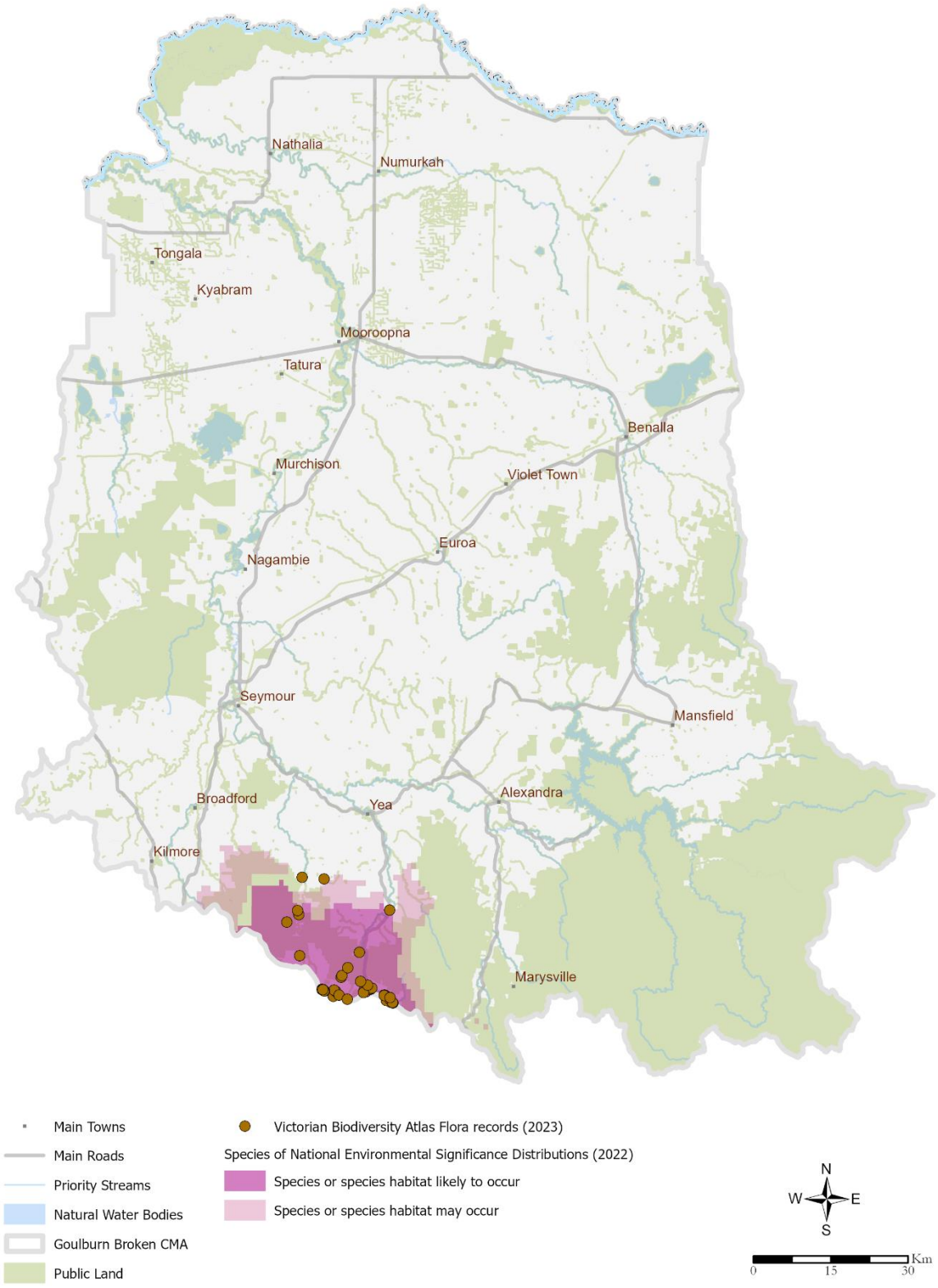


*Figure 14 Map of estimated distribution of **Spiny Rice-flower (Pimelea spinescens subsp. spinescens)** within the Goulburn Broken catchment based on Victorian Biodiversity Atlas records.*

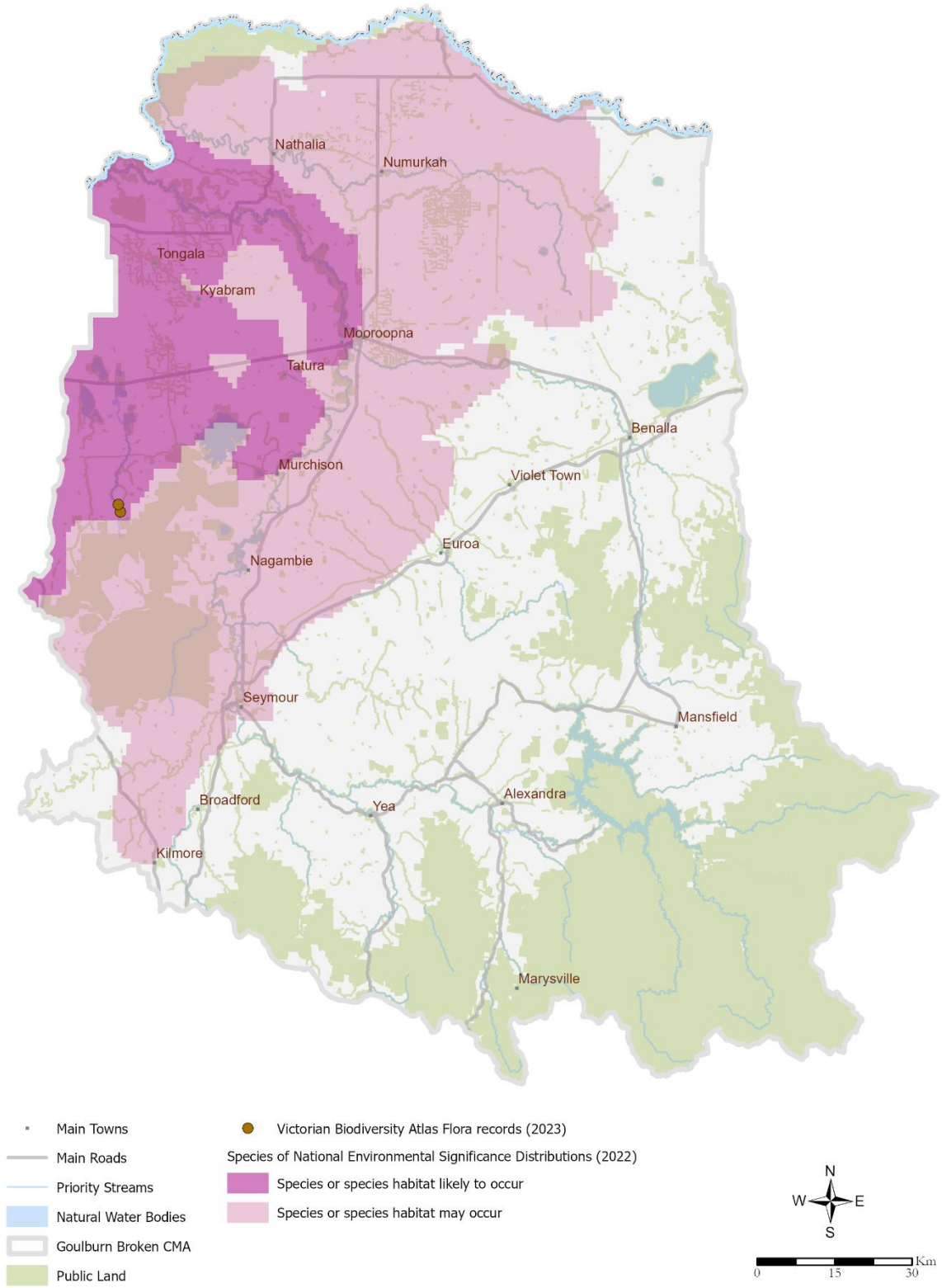


*Figure 15 Map of estimated distribution of **Australasian Bittern (Botaurus poiciloptilus)** within the Goulburn Broken catchment based on Victorian Biodiversity Atlas records.*

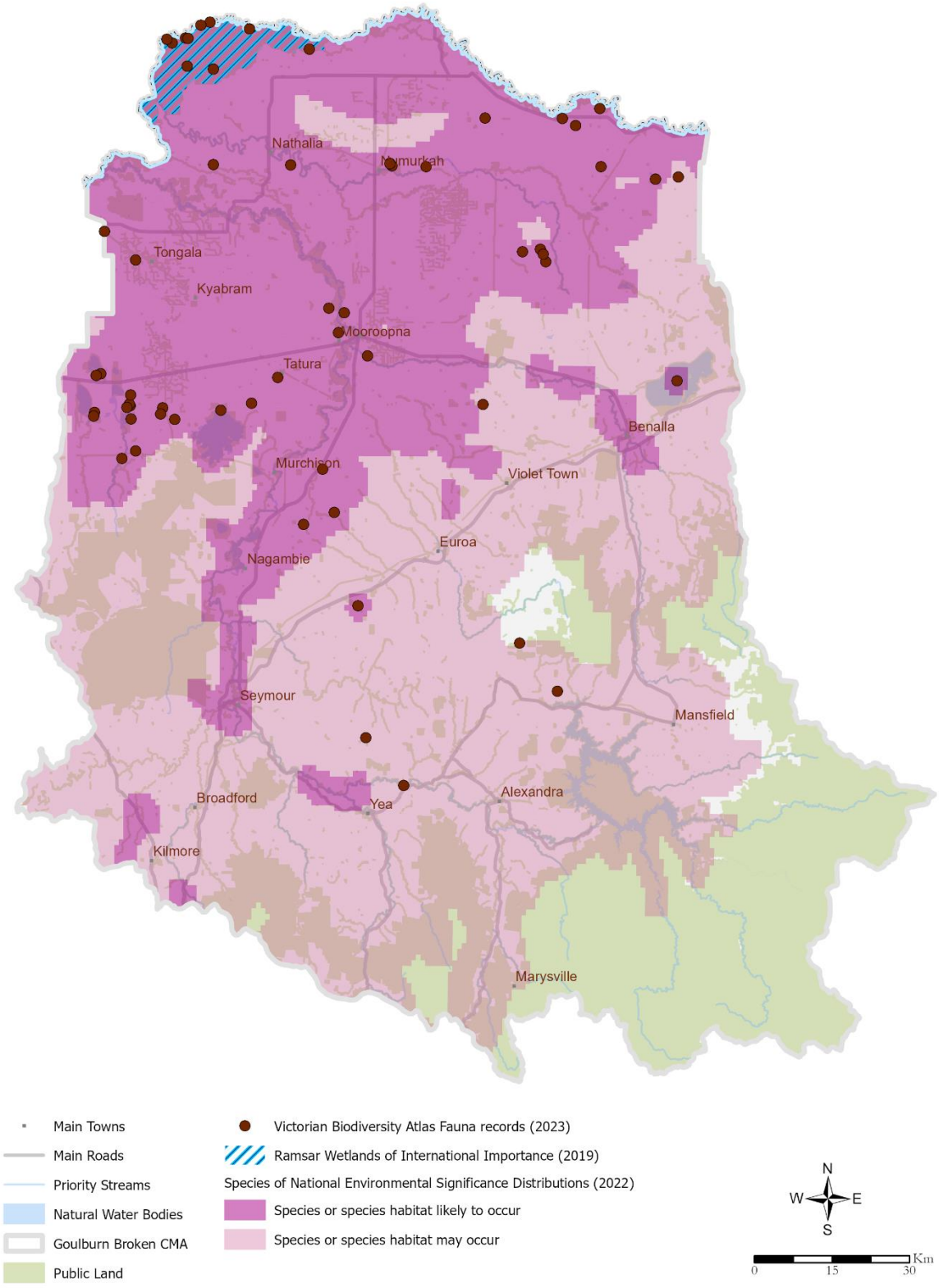


*Figure 16 Map of estimated distribution of **Mountain Pygmy-possum (Burramys parvus)** within the Goulburn Broken catchment based on Victorian Biodiversity Atlas records.*

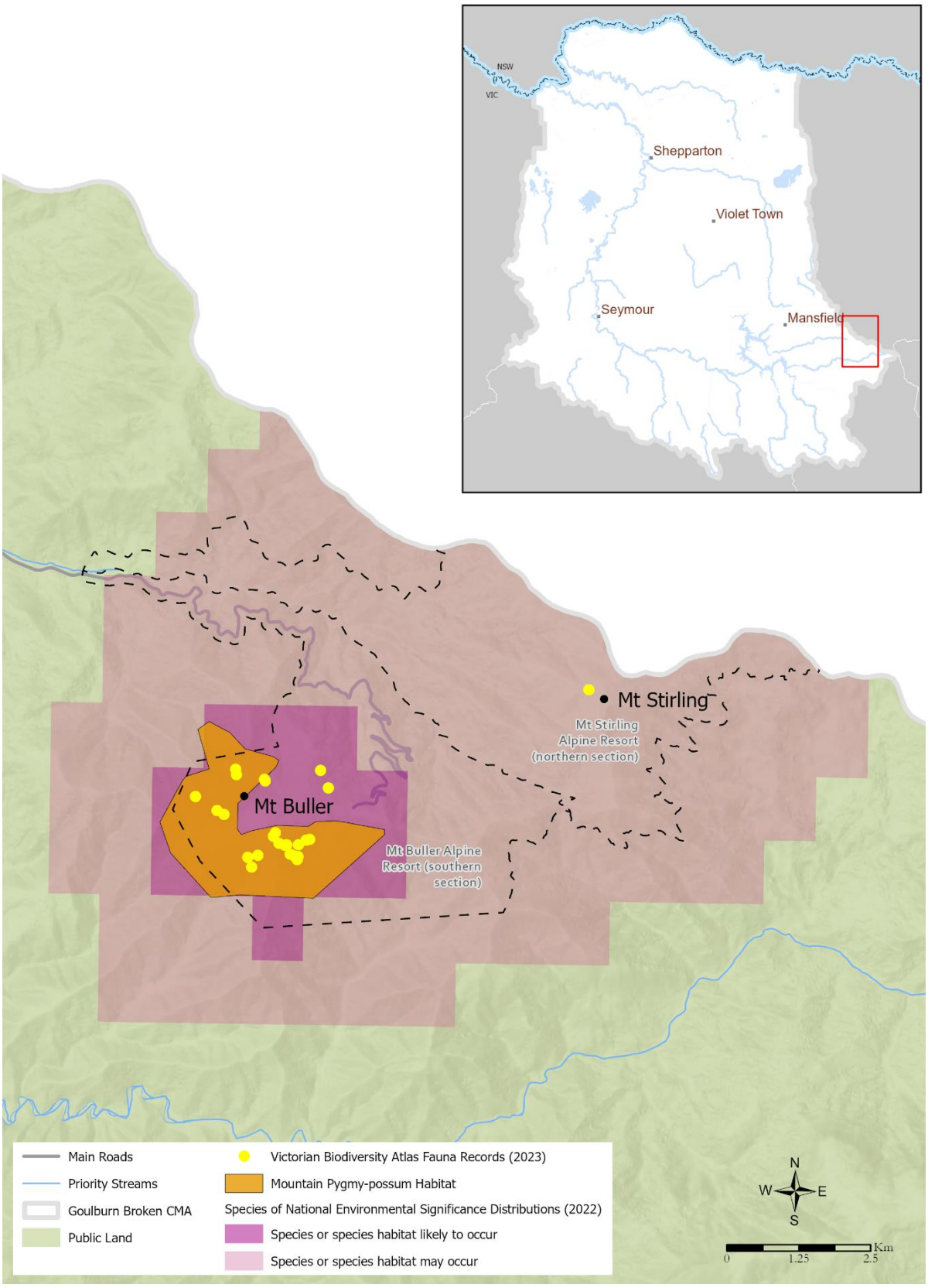


*Figure 17 Map of estimated distribution of **Stiff Groundsel (Senecio behrianus)** within the Goulburn Broken catchment based on Victorian Biodiversity Atlas records.*

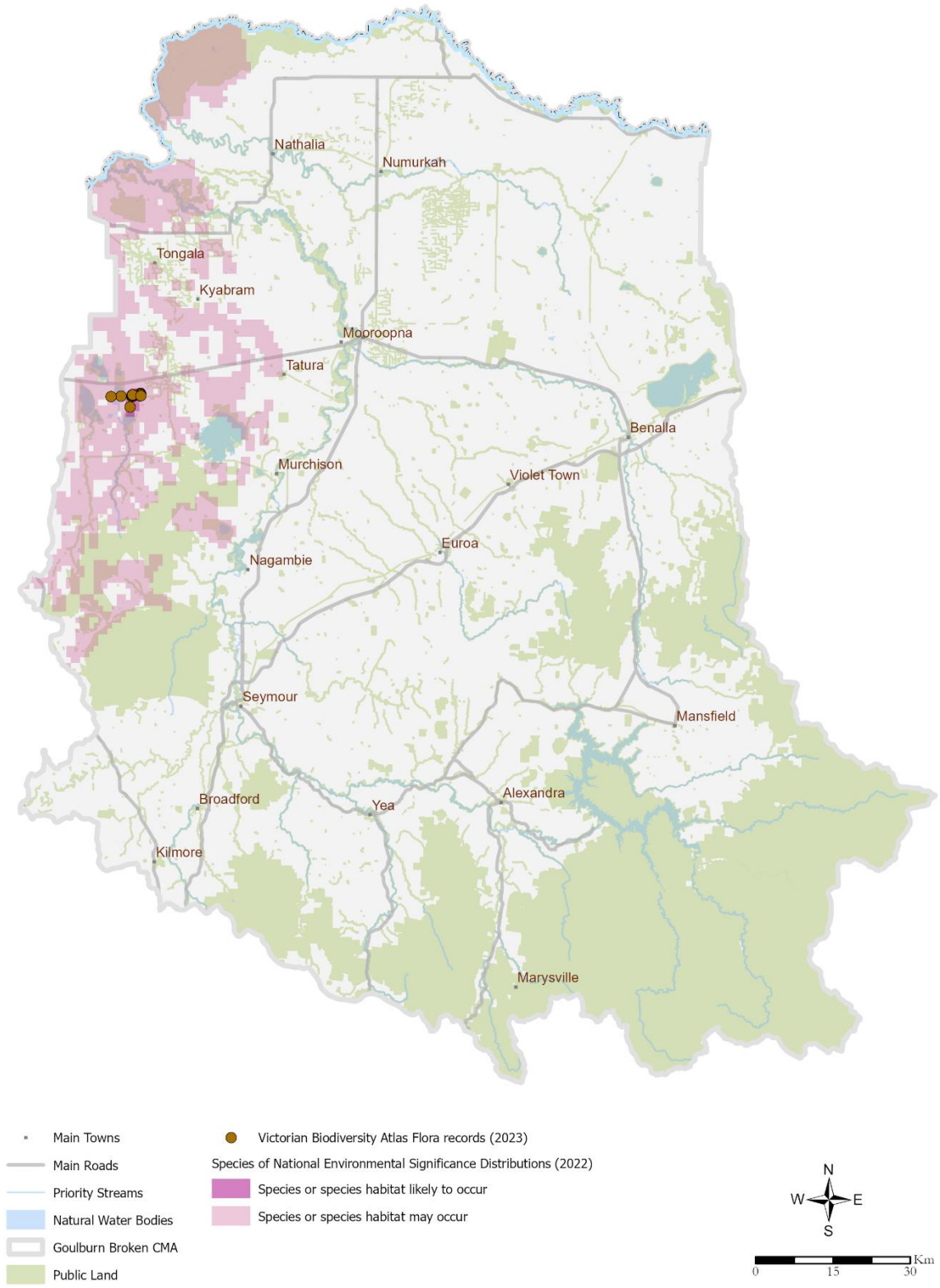


Figure 18 Map of estimated distribution of ***Lima Stringybark (Eucalyptus alligatrix subsp. limaensis)*** *within the Goulburn Broken catchment based on Victorian Biodiversity Atlas records.*

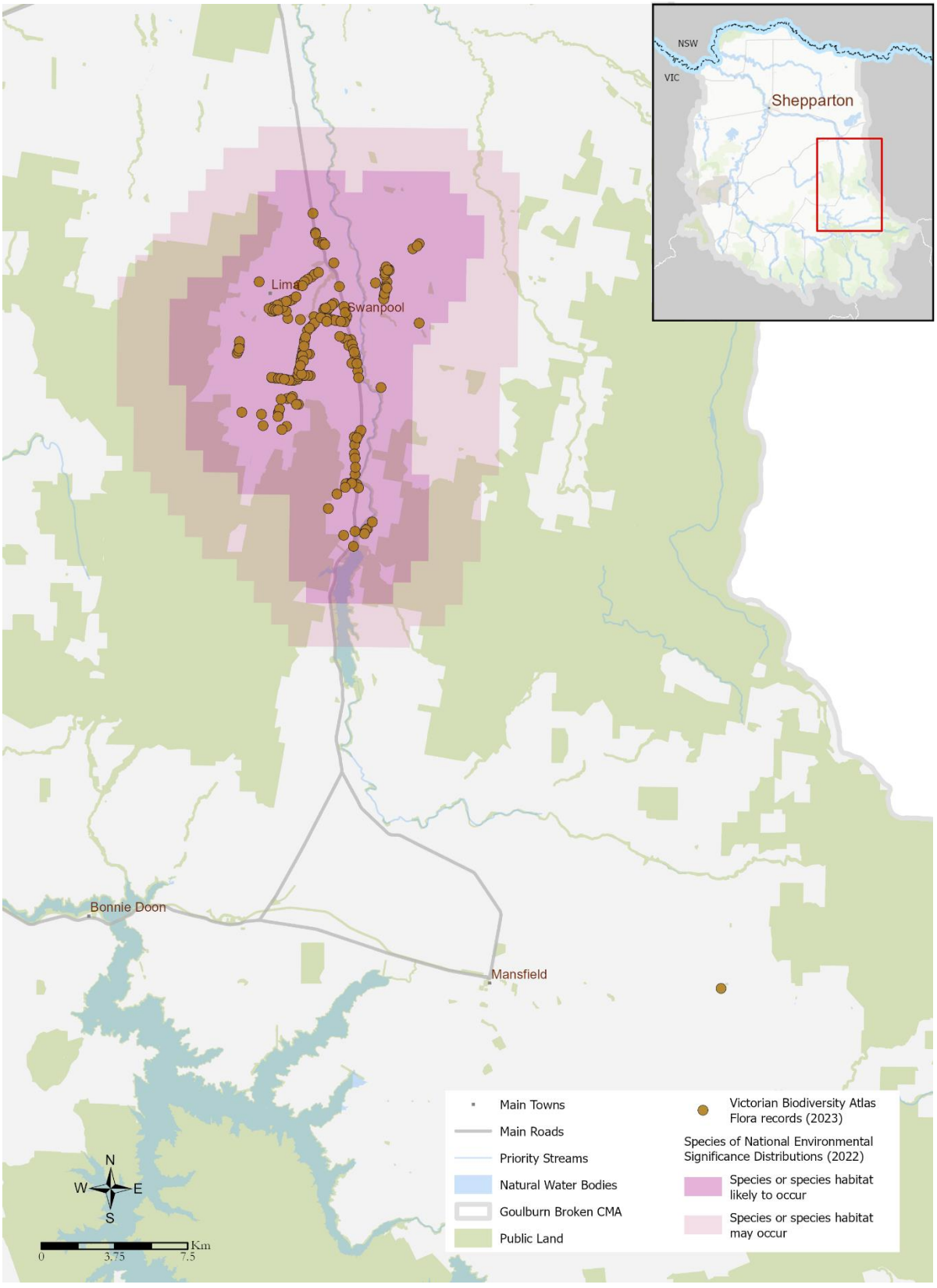


*Figure 19 Map of estimated distribution of **Buxton Gum (Eucalyptus crenulata)** within the Goulburn Broken catchment based on Victorian Biodiversity Atlas records.*

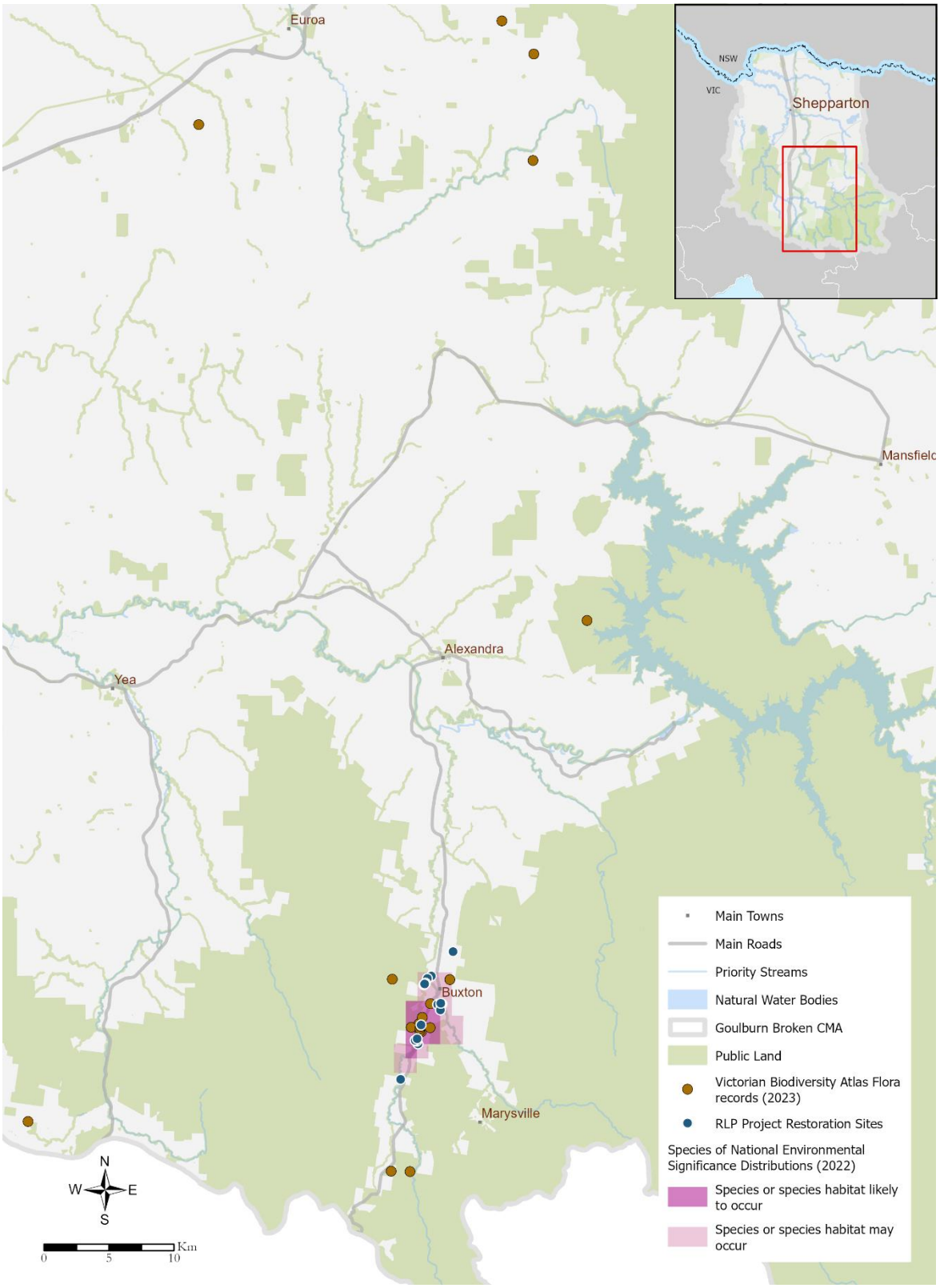


*Figure 20 Map of estimated distribution of **Superb Parrot (Polytelis swainsonii)** within the Goulburn Broken catchment based on Victorian Biodiversity Atlas records.*

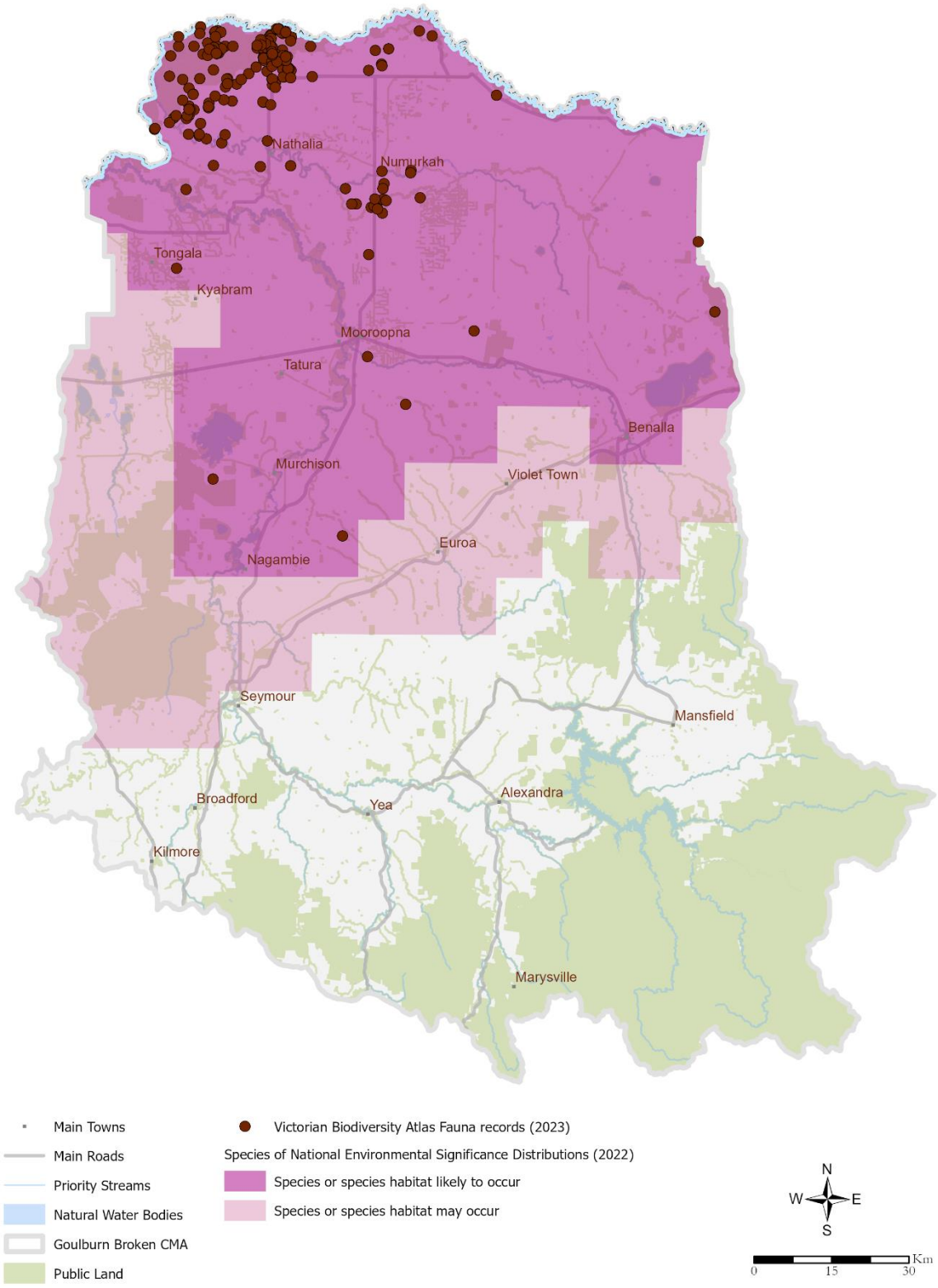


*Figure 21 Map of estimated distribution of **Growling Grass Frog (Litoria raniformis)** within the Goulburn Broken catchment based on Victorian Biodiversity Atlas records.*

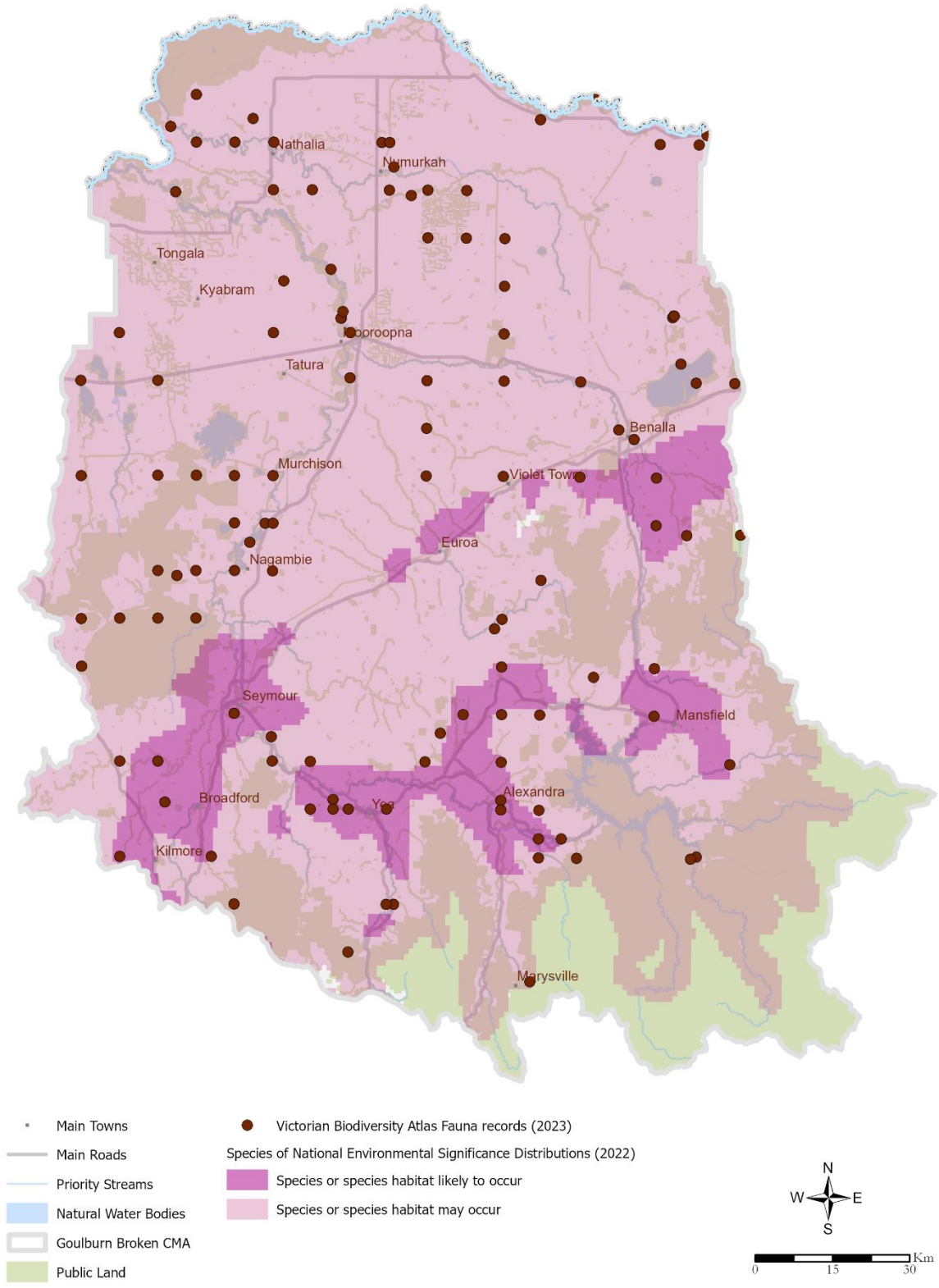


*Figure 22 Map of estimated distribution of **Grey-headed Flying Fox (Pteropus poliocephalus)** within the Goulburn Broken catchment based on Victorian Biodiversity Atlas records.*

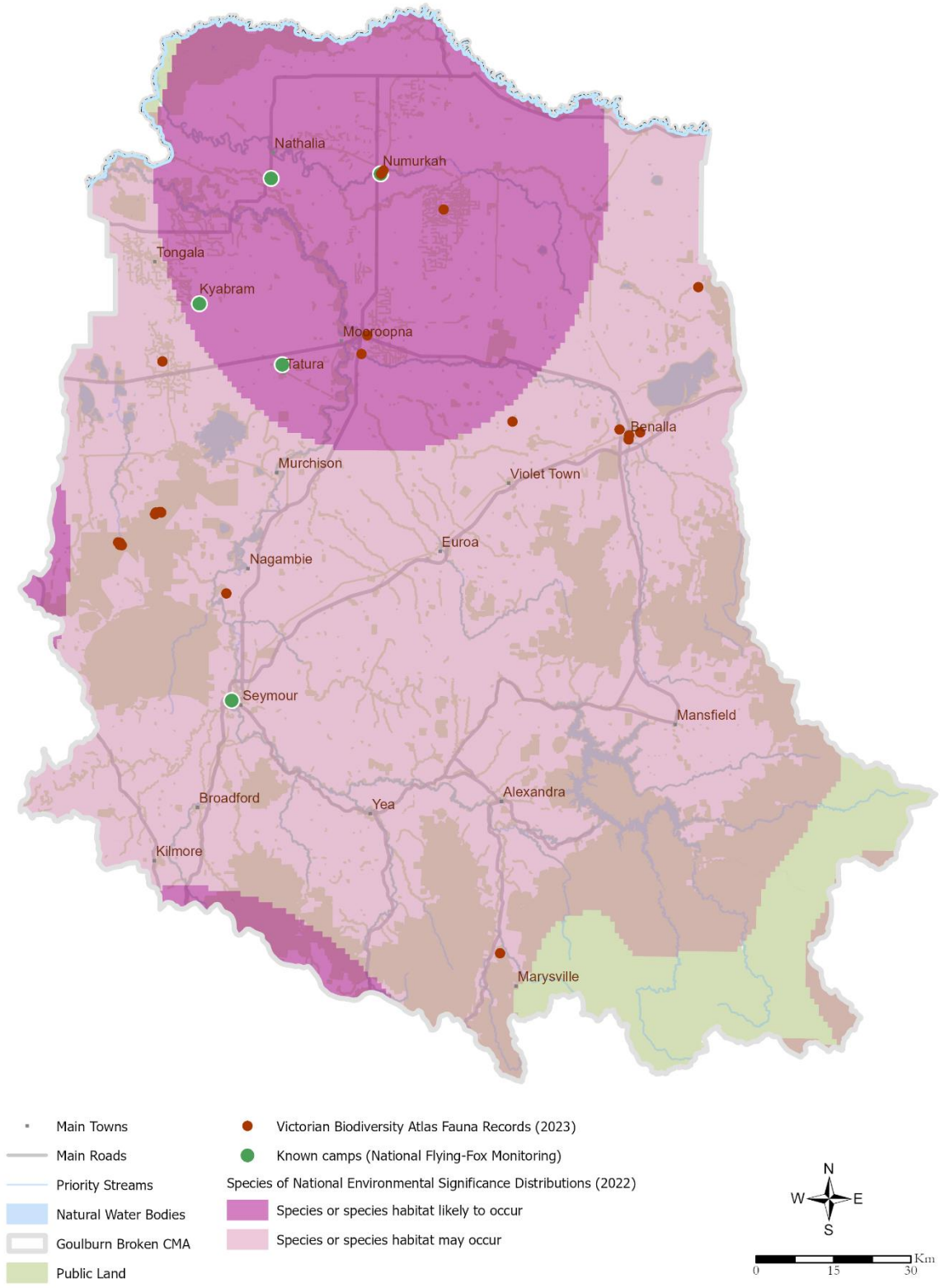


Figure 23 Map of estimated distribution of other nationally ***threatened flora species associated with woodland and/or grassland ecological communities*** *within the Goulburn Broken catchment, based on Victorian Biodiversity Atlas records.*

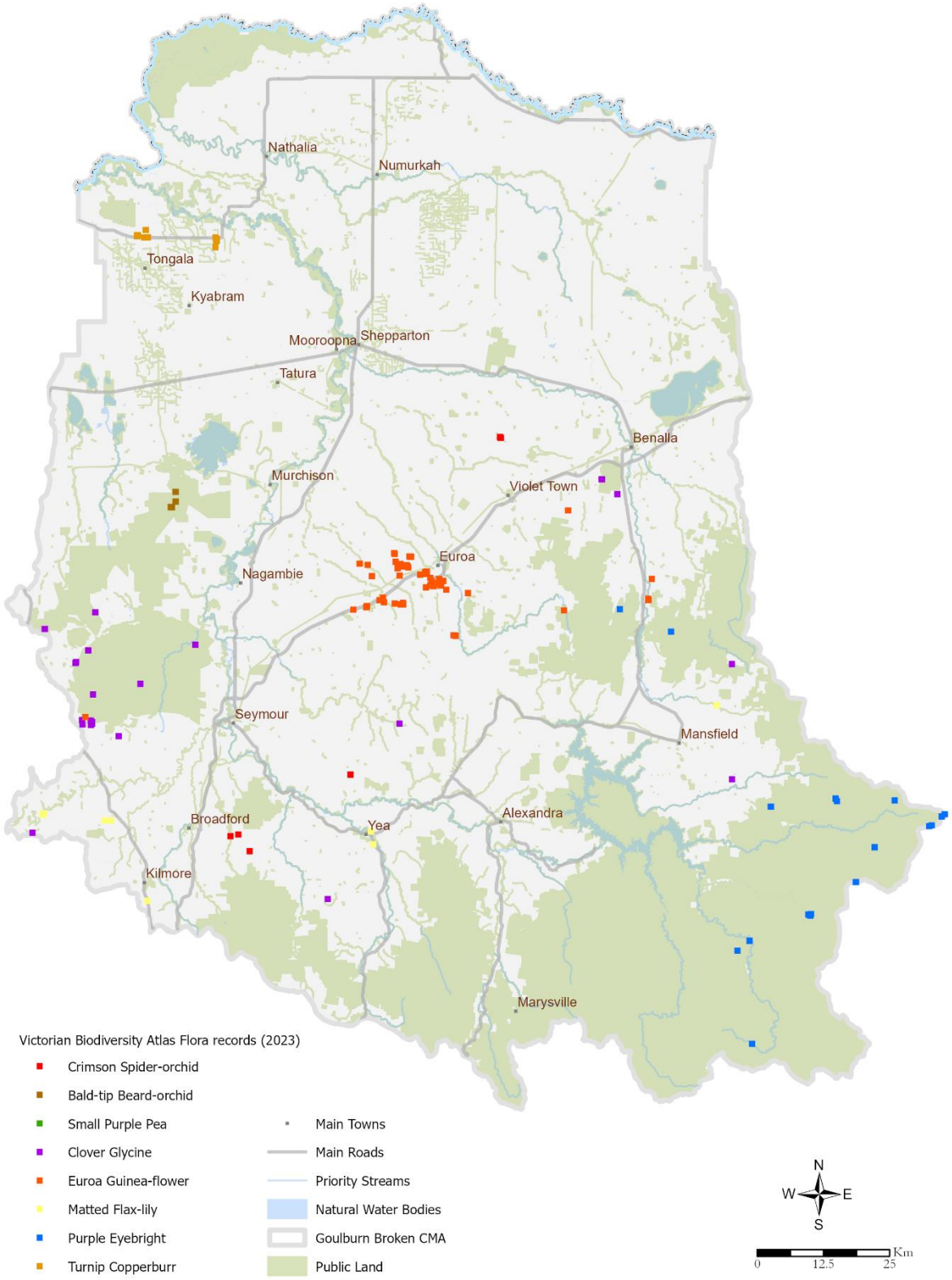


Figure 24 Map of estimated distribution of other nationally ***threatened fauna species associated with woodland and/or grassland ecological communities*** *within the Goulburn Broken catchment, based on Victorian Biodiversity Atlas records.*

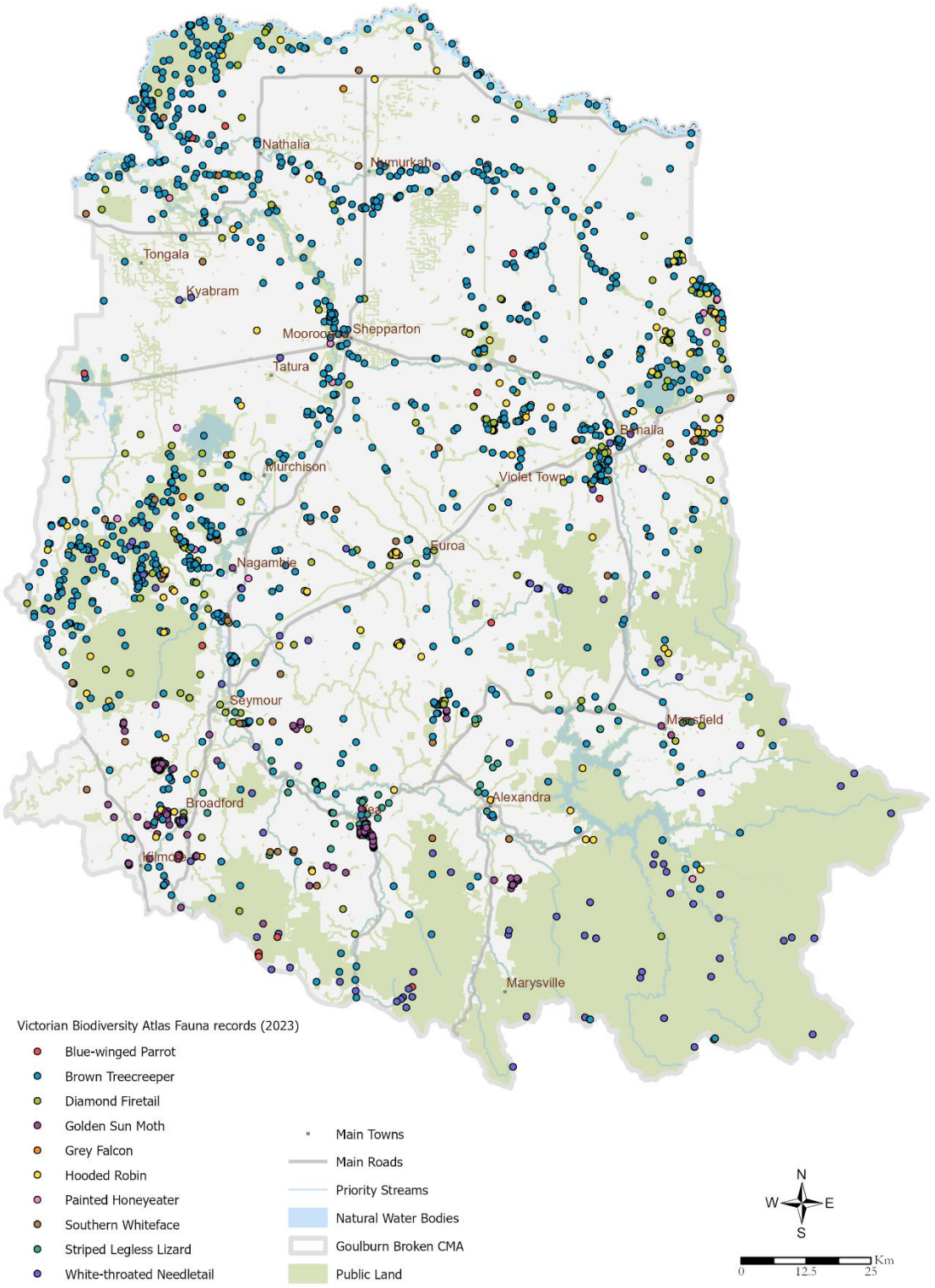


Figure 25 Map of estimated distribution of other nationally ***threatened flora and fauna species associated with floodplain and/or wetland ecological communities*** *within the Goulburn Broken catchment, based on Victorian Biodiversity Atlas records.*

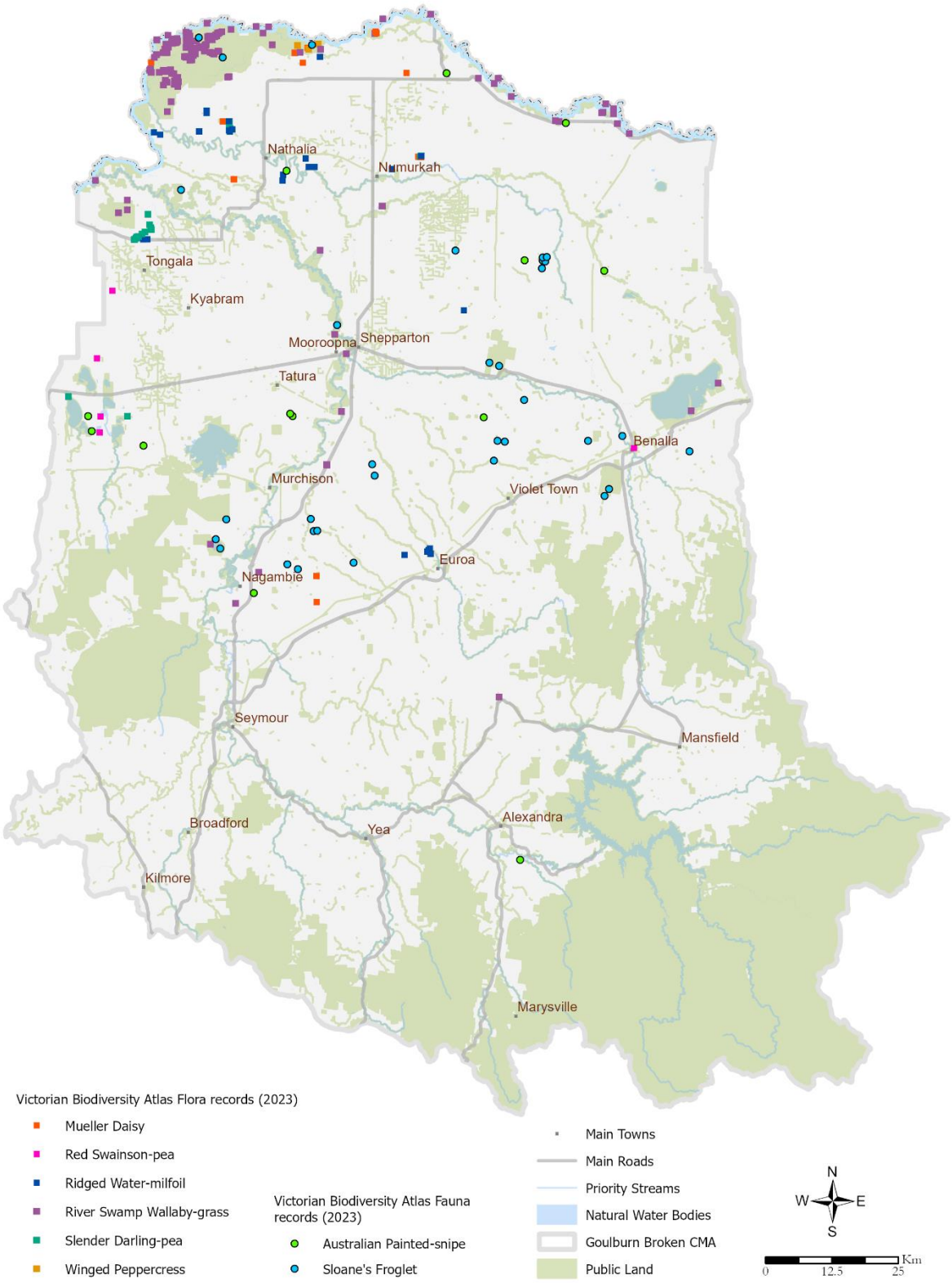
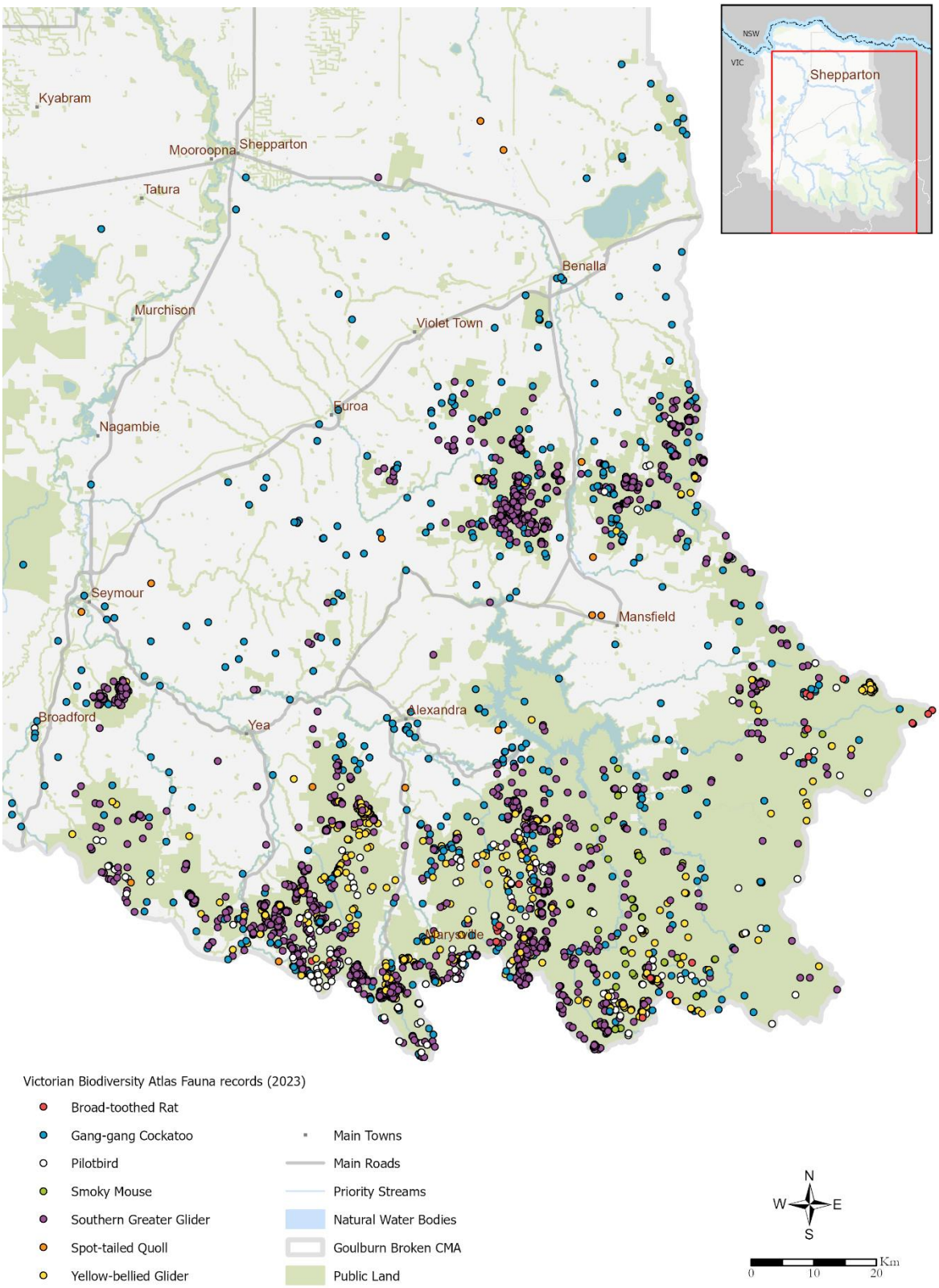


Figure 26 Map of estimated distribution of other nationally ***threatened fauna species associated with montane forest and/or alpine ecological communities*** *within the Goulburn Broken catchment, based on Victorian Biodiversity Atlas records.*



Agricultural natural capital assets

All agricultural natural capital assets within the Goulburn Broken catchment are presented together in a single map (Figure 27). The map is based on Victoria's Land Cover Time series (VLCTS) data for the period 2015-2019.

Agricultural soil assets

The six agricultural land use categories contained within the VCLTS data are combined into a single category to represent productive agricultural soils: Horticulture/irrigated pastures and crops, Dryland cropping, Exotic pasture/grassland, Hardwood plantation, Conifer plantation, Other exotic tree cover.

Riparian Areas, Native Vegetation, Agroforestry and Environmental Plantings on Farms

To represent these various forms of planted or remnant vegetation on farms, the seven natural environment land use categories from the VCLTS are combined into a single category: Treed native vegetation, Scattered native trees, Native shrubland, Native pasture/grassland, Natural low cover, Wetland – perennial, Wetland – seasonal.

Water assets

The map shows the location of waterways including major rivers, streams, and wetlands based on data available from Victoria’s DataVic platform.

Figure 27 Map of agricultural natural capital assets within the Goulburn Broken catchment. 'Agricultural land' represents the location of productive agricultural soils, 'native vegetation' represents where planted or remnant integrated vegetation is likely to occur within agricultural areas, and 'wetlands and waterways' represent the location of natural water assets and riparian zones.

Emergency event risk mapping

Bushfire

The Goulburn Broken CMA worked with DEECA staff and other Victorian CMAs to deliver bushfire risk mapping for this Plan. The fire behaviour simulations used to generate these maps were conducted using Phoenix RapidFire, a computerised bushfire model used by Victorian and other state fire agencies including DEECA and the Country Fire Authority (CFA) to model the behaviour of actual and potential fires. To look at potential bushfire impacts, fires are simulated across Victoria from ignitions within each cell of a 2km grid across the state.

Two maps are presented in this section:

- 'Intensity counts': this data represents the total number of ignitions impacting each cell. This measure can be used to provide a crude ranking of locations that are more 'hazardous' than others (Figure 28).
- 'Intensity maximum': this data represents the worst modelled fireline intensity from any of the 70,000+ simulations used in the analysis, if using the worst-case fuel and weather scenario. This measure indicates the relative risk of severe (intense) bushfire and can be used as a 'worst-case' option for a conservative risk assessment (Figure 29).

DEECA's Bushfire Risk, Engagement and Predictive Services team provided additional supporting information in Appendix 3 to accompany these maps.

Figure 28 Map of relative bushfire risk based on count intensity (percentile).

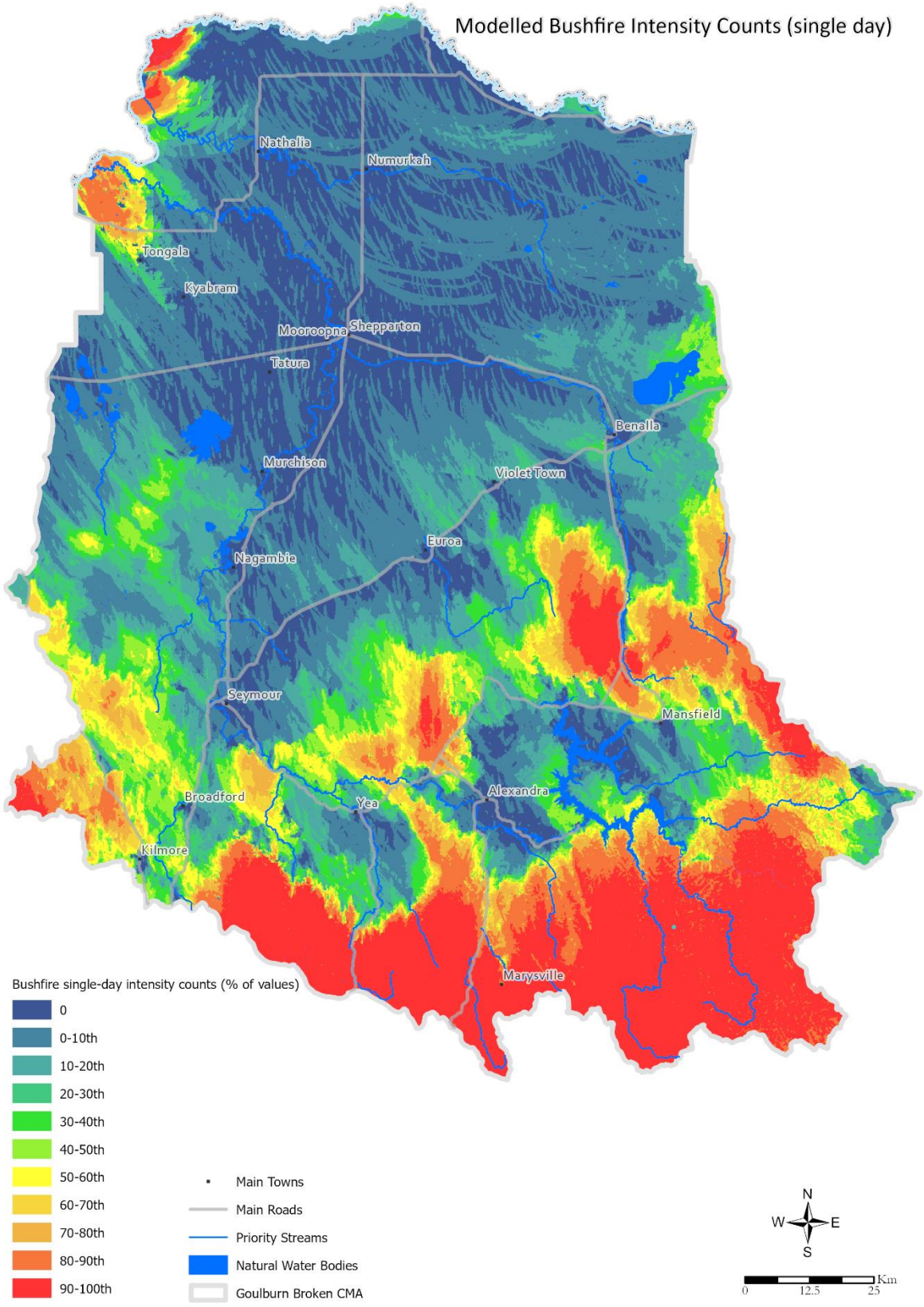
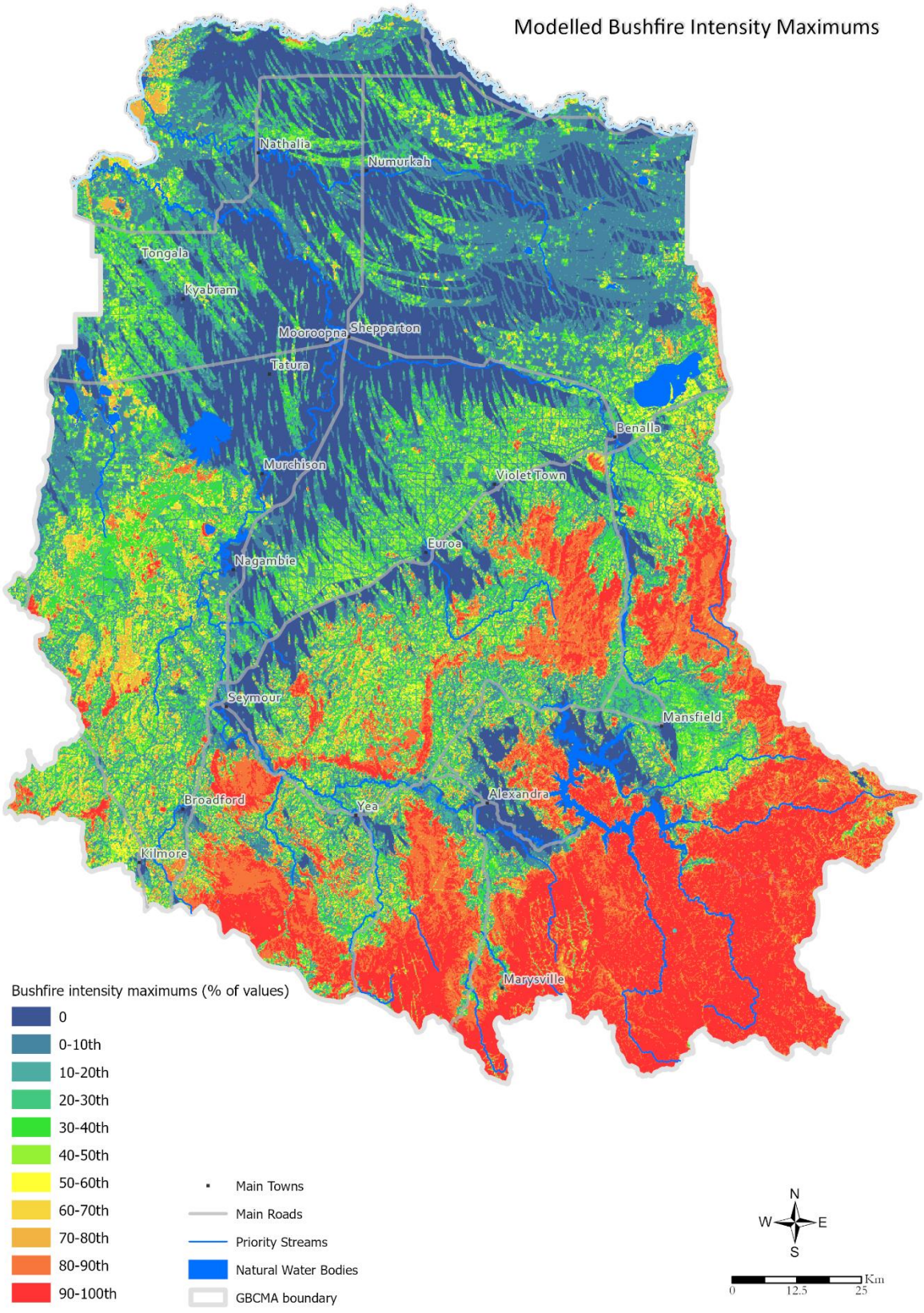


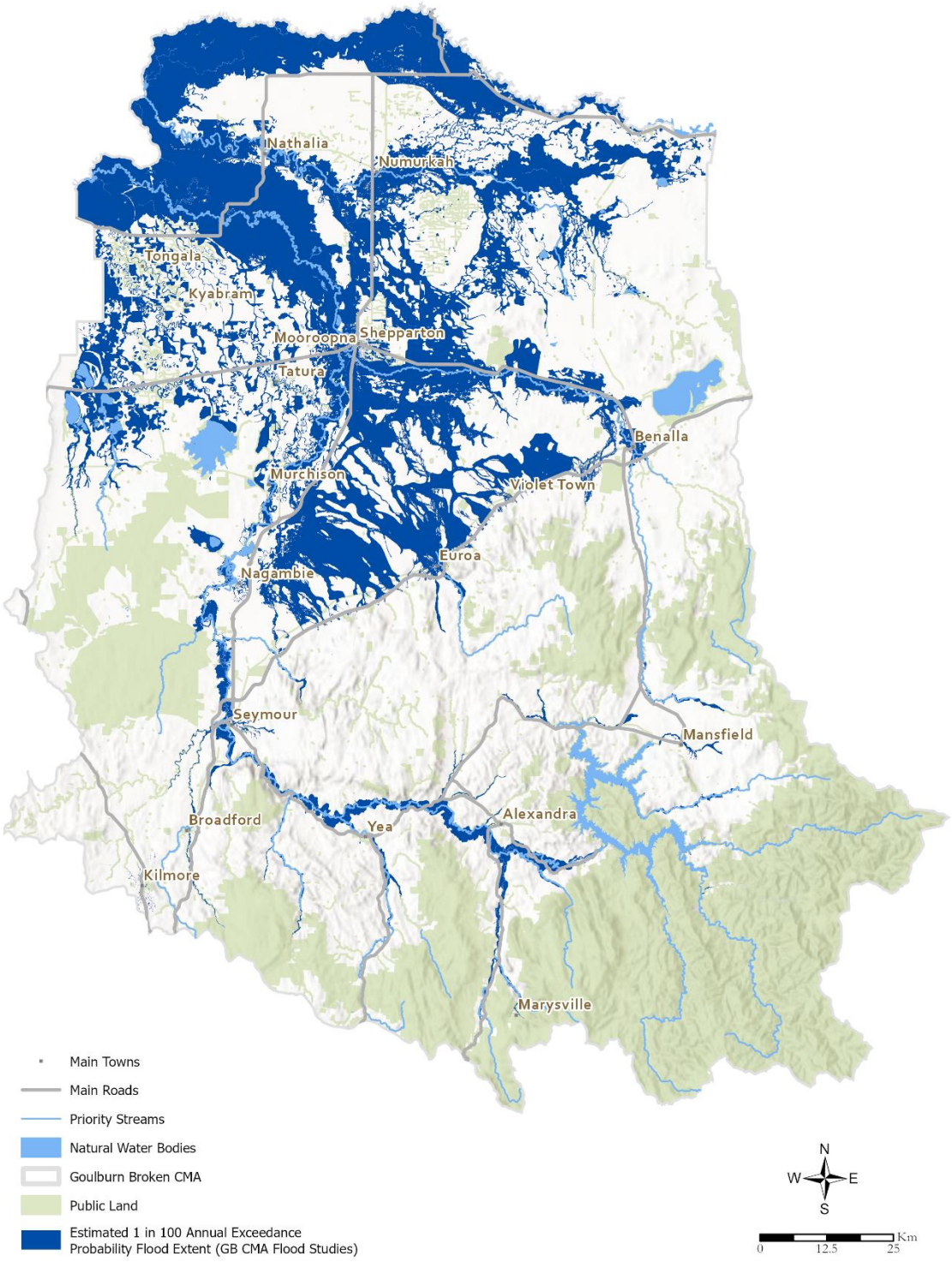
Figure 29 Map of relative bushfire risk based on maximum intensity (processed quantile).



Flooding

The flood map shows the best estimate of the 1 in 100 annual exceedance probability (AEP) flood extent across the Goulburn Broken catchment. This layer was created by the Goulburn Broken CMA using a combination of flood modelling, historic flood extents and Planning Scheme Zones/Overlays.

Figure 30 Estimated extent of the 1 in 100 AEP flood across the Goulburn Broken catchment.



Milestone 3a. Deliverable 1.

Appendix 2. Multi-jurisdictional inventory of assets

Purpose of this document

This document addresses Milestone 3a, Deliverable 1 of the Work Order by providing a final multi-jurisdictional inventory of biodiversity and agricultural natural capital assets present in the Goulburn Broken Management Unit to include in emergency response management and planning systems.

Biodiversity assets

Threatened ecological communities

Table 1

Table 3provides a multi-jurisdictional inventory of nationally threatened ecological communities located in the Goulburn Broken catchment and included in the region's Emergency Preparedness, Response, and Recovery Plan.

Table 1. Multi-jurisdictional inventory of threatened ecological communities.

Threatened ecological communities (TEC)	Jurisdiction	Corresponding ecological community in state and territory jurisdictions	Legislation the asset is protected under	Conservation status	Extreme events and environmental disasters	Description of extent
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	Commonwealth	Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	*Environment Protection and Biodiversity Conservation Act 1999*	Critically Endangered	Bushfire Drought	Occurs in Victoria, south-eastern South Australia (SA) and southern New South Wales (NSW), specifically within IBRA bioregions associated with lowland plains, but may also extend into lower slopes that grade into the plains (e.g. parts of the Victorian Midlands and NSW South-western Slopes bioregions).
	Victoria	Herb-rich Plains Grassy Wetland (West Gippsland) Community	*Flora and Fauna Guarantee Act 1988*	Threatened		
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and	Commonwealth	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	*Environment Protection and Biodiversity Conservation Act 1999*	Critically Endangered	Bushfire Drought Flood	Broadly distributed in an arc along the western slopes and tablelands of the Great Dividing Range from Southern Queensland through NSW and ACT, to Victoria.

Threatened ecological communities (TEC)	Jurisdiction	Corresponding ecological community in state and territory jurisdictions	Legislation the asset is protected under	Conservation status	Extreme events and environmental disasters	Description of extent
Derived Native Grassland	Victoria	Limestone Grassy Woodland Community	*Flora and Fauna Guarantee Act 1988*	Threatened		Occurring in the Brigalow Belt South, Nandewar, New England Tableland, South Eastern Queensland, Sydney Basin, NSW North Coast, South Eastern Highlands, South East Corner, NSW South Western Slopes, Victorian Midlands and Riverina IBRA bioregions.
	Australian Capital Territory	Yellow Box – Red Gum Grassy Woodland	*Nature Conservation Act 2014*	Endangered		
	New South Wales	White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions	*Biodiversity Conservation Act 2016*	Critically Endangered		
	Queensland	A number of Regional Ecosystems relate to the nationally-listed ecological community	*Vegetation Management Act 1999*	Of Concern or Endangered		
Natural Grasslands of the Murray Valley Plains	Commonwealth	Natural Grasslands of the Murray Valley Plains	*Environment Protection and Biodiversity Conservation Act 1999*	Critically Endangered	Bushfire Drought	Occurs predominately across the southern parts of the Riverina Bioregion in NSW and Victoria, and the Wimmera plains of Victoria. Outlying occurrences extend into adjacent parts of the Murray Mallee Subregion and the NSW South Western Slopes Bioregion.
	Victoria	Northern Plains Grasslands	*Flora and Fauna Guarantee Act 1988*	Threatened		
Alpine Sphagnum Bogs and Associated Fens	New South Wales	Montane peatlands and swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern	*Threatened Species Conservation Act 1995*	Endangered	Bushfire Drought Heatwave	Found in small pockets across alpine, subalpine and some montane areas of Tasmania, Victoria, NSW, and the ACT.

Threatened ecological communities (TEC)	Jurisdiction	Corresponding ecological community in state and territory jurisdictions	Legislation the asset is protected under	Conservation status	Extreme events and environmental disasters	Description of extent
		Highlands and Australian Alps bioregions				
	Australian Capital Territory	High Country Bogs and Associated Fens (bogs and fens) community is consistent but includes some bogs and fens at lower elevation	*Nature Conservation Act 2014*	Endangered		
	Victoria	Alpine Bog Community, Fen (Bog Pool) Community, and Caltha introloba Herbland Community	*Flora and Fauna Guarantee Act 1988*	Threatened		
	Tasmania	Sphagnum peatland	*Nature Conservation Act 2002*	Rare		
Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Commonwealth	Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	*Environment Protection and Biodiversity Conservation Act 1999*	Endangered	Bushfire Drought Flood	Occurs predominantly on the drier edge of the temperate grassy eucalypt woodland belt, ranging from the Narrabri district in central NSW through northern Victoria into South Australia. Patches that are disjunct from the main grey box woodland belt occur in the Victorian Volcanic Plain to the west of Melbourne, as well as in the Flinders and Mount Lofty Ranges near Adelaide in South Australia.
	Victoria	Grey Box – Buloke Grassy Woodland Community	*Flora and Fauna Guarantee Act 1988*	Threatened		
		Victorian temperate-woodland bird community	*Flora and Fauna Guarantee Act 1988*	Threatened		
	New South Wales	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	*Biodiversity Conservation Act 2016*	Endangered		
	South Australia	*Eucalyptus microcarpa* grassy woodland on cracking clays on plains	*Provisional List of Threatened Ecosystems in South Australia 2001*	Endangered		

Threatened ecological communities (TEC)	Jurisdiction	Corresponding ecological community in state and territory jurisdictions	Legislation the asset is protected under	Conservation status	Extreme events and environmental disasters	Description of extent
		Eucalyptus microcarpa grassy low woodland on foothills and hill slopes of southern Mount Lofty Ranges	*Provisional List of Threatened Ecosystems in South Australia 2001*	Endangered		
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions	South Australia	*Eucalyptus microcarpa* grassy woodland on cracking clays on plains	*Provisional List of Threatened Ecosystems in South Australia 2001*	Endangered	Bushfire Drought Flood	Distributed widely across the Riverina and Murray-Darling Depression bioregions, occurring in tracts or as patches within open-forests or woodlands often dominated by other species (e.g. Grey Box).
	Victoria	*Eucalyptus microcarpa* grassy low woodland on foothills and hill slopes of southern Mount Lofty Ranges	*Provisional List of Threatened Ecosystems in South Australia 2001*	Endangered		
		Semi-arid Herbaceous Pine Buloke Woodland Community	*Flora and Fauna Guarantee Act 1988*	Threatened		
		Semi-arid North-west Plains Buloke Grassy Woodlands Community	*Flora and Fauna Guarantee Act 1988*	Threatened		
		Semi-arid Shrubby Pine-Buloke Woodland Community	*Flora and Fauna Guarantee Act 1988*	Threatened		
	New South Wales	*Allocasuarina luehmannii* Woodland in the Riverina and Murray-Darling Depression Bioregions	*Biodiversity Conservation Act 2016*	Endangered		
	South Australia	Buloke Woodlands	n/a	Not listed		

Ramsar sites

Table 2 lists the sole Ramsar site located within the Goulburn Broken catchment: The Barmah Forest Ramsar site.

Table 2. Ramsar sites within the Goulburn Broken catchment.

Ramsar sites	Jurisdiction	Legislation the asset is protected under	Other relevant agreements	Extreme events and environmental disasters	Description of extent
Barmah Forest Ramsar Site	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Ramsar Convention on Wetlands of International Importance	Bushfire Drought Heatwave Flood	The Barmah Forest Ramsar site is located on the northern boundary of the Goulburn Broken catchment on the Murray River. It consists of the section of the Murray River floodplain within Victoria (i.e. south of the main river channel) between the downstream end of the Ulupna Island and Barmah Township, covering approximately 28,515 hectares. While the Barmah Forest Ramsar site is contained within the boundaries of the Goulburn Broken Management Unit, the site is part of the broader Barmah-Millewa Forest complex. The adjoining Millewa Forest is located immediately north of the site, within New South Wales.
			National Guidelines for Ramsar Wetlands		
	Victoria		The Victorian Waterway Management Strategy sets out Victoria's policy for managing Ramsar sites		

Threatened species

Table 3 provides a multi-jurisdictional inventory of nationally threatened species included in the Goulburn Broken Emergency Preparedness, Response, and Recovery Plan.

Table 3. Multi-jurisdictional inventory of nationally threatened species.

Species	Jurisdiction	Legislation the asset is protected under	Conservation status	Extreme events and environmental disasters	Description of extent
Flat-headed Galaxias (*Galaxias rostratus*)	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Critically Endangered	Bushfire Drought Heatwave	Only known from the southern half of the Murray-Darling Basin system.
	Victoria	*Flora and Fauna Guarantee Act 1988*	Vulnerable		

Species	Jurisdiction	Legislation the asset is protected under	Conservation status	Extreme events and environmental disasters	Description of extent
	New South Wales	*Biodiversity Conservation Act 2016*	Critically Endangered	Flood	
Silver Perch *(Bidyanus bidyanus)*	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Critically Endangered	Bushfire Drought Heatwave Flood	Endemic to the Murray-Darling system (including all states and sub-basins). Commonly described as a lowland species that are not found in the cooler upper reaches of rivers, however they are known to reside or seasonally migrate into upland river habitats.
	Victoria	*Flora and Fauna Guarantee Act 1988*	Endangered		
	New South Wales	*Biodiversity Conservation Act 2016*	Vulnerable		
	Australian Capital Territory	*Nature Conservation Act 2014*	Critically Endangered		
	South Australia	*National Parks and Wildlife Act 19721*	Critically Endangered		
Barred Galaxias *(Galaxias fuscus)*	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Endangered	Bushfire Drought Heatwave Flood	Endemic to a small upland area in the south-eastern portion of the Goulburn River system in central Victoria, on the Murray-Darling Basin side of the Great Dividing Range in the South Eastern Highlands IBRA bioregion.
	Victoria	*Flora and Fauna Guarantee Act 1988*	Critically Endangered		
Trout Cod *(Maccullochella macquariensis)*	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Endangered	Bushfire Drought Heatwave Flood	Two potentially sustainable, breeding populations of Trout Cod are known: a naturally occurring population in the Murray River (NSW) downstream of the Yarrawonga Weir between Yarrawonga and Barmah, and the translocated population in Seven Creeks below Polly McQuinns Weir (Victoria).
	Victoria	*Flora and Fauna Guarantee Act 1988*	Endangered		
	Australian Capital Territory	*Nature Conservation Act 2014*	Endangered		
	New South Wales	*Fisheries Management Act 1994*	Endangered		
Macquarie Perch *(Macquaria australasica)*	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Endangered	Bushfire Drought Heatwave Flood	Extant populations are still found across the Murray-Darling Basin, typically in the cool, upper reaches of drainage systems located in southern NSW, the ACT and northern Victoria.
	Victoria	*Flora and Fauna Guarantee Act 1988*	Endangered		
	Australian Capital Territory	*Nature Conservation Act 2014*	Endangered		
	New South Wales	*Fisheries Management Act 1994*	Endangered		

Species	Jurisdiction	Legislation the asset is protected under	Conservation status	Extreme events and environmental disasters	Description of extent
Murray Cod *(Maccullochella peelii)*	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Vulnerable	Bushfire Drought Heatwave Flood	Widely distributed in waterways of the Murray-Darling Basin.
	Victoria	*Flora and Fauna Guarantee Act 1988*	Endangered		
Southern Pygmy Perch *(Nannoperca australis)* (Murray-Darling lineage)	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Vulnerable	Bushfire Drought Heatwave Flood	Remnant populations remain in a tributary of the Lachlan River, and two tributaries of the Murray River (NSW); the Mitta Mitta, Kiewa, Ovens, Goulburn-Broken, Campaspe, Avoca, and Wimmera River catchments (Victoria); and tributaries draining into the lower Murray River in the Mount Lofty ranges and the Lower Lakes (South Australia).
	Victoria	*Flora and Fauna Guarantee Act 1988*	Vulnerable		
	New South Wales	*Biodiversity Conservation Act 2016*	Endangered		
	South Australia	*National Parks and Wildlife Act 19721*	Endangered		
Swift Parrot (*Lathamus discolor*)	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Critically Endangered	Bushfire Drought	The breeding range of the Swift Parrot is largely restricted to the east and south-east coast of Tasmania. The entire population migrates north to mainland Australia for the winter, with the majority being found in Victoria and New South Wales.
	Victoria	*Flora and Fauna Guarantee Act 1988*	Critically Endangered		
	Australian Capital Territory	*Nature Conservation Act 2014*	Critically Endangered		
	New South Wales	*Biodiversity Conservation Act 2016*	Endangered		
	Queensland	*Nature Conservation (Animals) Regulation 2020*	Endangered		
	South Australia	*National Parks and Wildlife Act 1972*	Endangered		
	Tasmania	*Threatened Species Protection Act 1995*	Endangered		
Regent Honeyeater *(Anthochaera phrygia)*	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Critically Endangered	Bushfire Drought	Endemic to mainland south-eastern Australia, with a patchy distribution extending from south-east Queensland, through NSW and the ACT, to central Victoria.
	Victoria	*Flora and Fauna Guarantee Act 1988*	Critically Endangered		
	New South Wales	*Biodiversity Conservation Act 2016*	Critically Endangered		

Species	Jurisdiction	Legislation the asset is protected under	Conservation status	Extreme events and environmental disasters	Description of extent
	South Australia	*National Parks and Wildlife Act 1972*	Endangered		
	Australian Capital Territory	*Nature Conservation Act 2014*	Critically Endangered		
	Queensland	*Nature Conservation (Animals) Regulation 2020*	Critically Endangered		
Leadbeater's Possum *(Gymnobelideus leadbeateri)*	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Critically Endangered	Bushfire Drought Heatwave	Endemic to Victoria, consisting of two genetically distinct subpopulations that have historically occupied different habitats: the core location being an area of approximately 70 x 80 km in the Central Highlands of Victoria, and an outlier 'lowland population' located at Cockatoo Swamp near Yellingbo.
	Victoria	*Flora and Fauna Guarantee Act 1988*	Critically Endangered		
Spotted Tree Frog *(Litoria spenceri)*	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Critically Endangered	Bushfire Drought Flooding	Restricted to a small region of the Great Dividing Range in south-east Australia, between Mount Kosciusko in southern NSW and the Central Highlands of Victoria.
	Victoria	*Flora and Fauna Guarantee Act 1988*	Critically Endangered		
	New South Wales	*Biodiversity Conservation Act 2016*	Critically Endangered		
Round-leaf Pomaderris *(Pomaderris vacciniifolia)*	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Critically Endangered	Bushfire Drought	Endemic to Victoria where it occurs in the middle and upper catchments of the Yarra River, extending marginally north into the headwaters of the Yea River and King Parrot Creek.
	Victoria	*Flora and Fauna Guarantee Act 1988*	Critically Endangered		
Spiny Rice-flower *(Pimelea spinescens subsp. Spinescens)*	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Critically Endangered	Bushfire	Endemic to Victoria, where it occurs in the central west of the state; predominantly in the Victorian Volcanic Plain, Victorian Midlands and Riverina IBRA bioregions.
	Victoria	*Flora and Fauna Guarantee Act 1988*	Critically Endangered		
Australasian Bittern	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Endangered	Drought	Occurs from south-east Queensland to south-east South Australia as far

Species	Jurisdiction	Legislation the asset is protected under	Conservation status	Extreme events and environmental disasters	Description of extent
(Botaurus poiciloptilus)	Victoria	*Flora and Fauna Guarantee Act 1988*	Critically Endangered	Bushfire	as the Adelaide Region, southern Eyre Peninsula, Tasmania and in the southwest of Western Australia.
	Australian Capital Territory	*Nature Conservation Act 2014*	Endangered		
	New South Wales	*Biodiversity Conservation Act 2016*	Endangered		
	Queensland	*Nature Conservation (Animals) Regulation 2020*	Endangered		
	South Australia	*National Parks and Wildlife Act 1972*	Endangered		
	Western Australia	*Biodiversity Conservation Act 2016*	Endangered		
Mountain Pygmy-possum *(Burramys parvus)*	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Endangered	Bushfire Heatwave	Endemic to alpine, sub-alpine and montane areas of mainland south-eastern Australia. Occurs in three separate regions: Kosciuszko National Park (NSW); Mt Buller (Victoria); and Mt Bogong Mt Higginbotham (Victoria). Populations of the three regions are highly genetically distinct from each other.
	Victoria	*Flora and Fauna Guarantee Act 1988*	Endangered		
	New South Wales	*Biodiversity Conservation Act 2016*	Endangered		
Stiff Groundsel *(Senecio behrianus)*	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Endangered	Bushfire Drought	Endemic to south-eastern Australia. Currently known from five wild populations, all in Victoria: four at Corop (in the Riverina and Murray-Darling Depression bioregions and one near Ballarat (in the Victorian Midlands bioregion).
	Victoria	*Flora and Fauna Guarantee Act 1988*	Critically Endangered		
	South Australia	*National Parks and Wildlife Act 1972*	Endangered		
Lima Stringybark *(Eucalyptus alligatrix subsp. limaensis)*	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Endangered	Bushfire Drought	Occurs in a valley in the Lima and Swanpool region, within the Victorian Midlands bioregion.
	Victoria	*Flora and Fauna Guarantee Act 1988*	Critically Endangered		
Buxton Gum *(Eucalyptus crenulata)*	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Endangered	Bushfire	Endemic to south central Victoria. Known from two natural populations: one in the Acheron River valley near
	Victoria	*Flora and Fauna Guarantee Act 1988*	Endangered		

Species	Jurisdiction	Legislation the asset is protected under	Conservation status	Extreme events and environmental disasters	Description of extent
					Buxton, and the second on the Yarra River floodplain at Yering.
Superb Parrot *(Polytelis swainsonii)*	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Vulnerable	Bushfire Drought Heatwave	The core range is west of the Great Dividing Range in NSW from Canberra (ACT), Goulburn and as far west as Nyngan and Swan Hill.
	Victoria	*Flora and Fauna Guarantee Act 1988*	Endangered		
	Australian Capital Territory	*Nature Conservation Act 2014*	Vulnerable		
	New South Wales	*Biodiversity Conservation Act 2016*	Vulnerable		
Growling Grass Frog *(Litoria raniformis)*	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Vulnerable	Drought Heatwave Bushfire Flood	Endemic to south-eastern Australia, including South Australia, Victoria, Tasmania, NSW, and the ACT.
	Victoria	*Flora and Fauna Guarantee Act 1988*	Vulnerable		
	Australian Capital Territory	*Nature Conservation Act 2014*	Vulnerable		
	New South Wales	*Biodiversity Conservation Act 2016*	Endangered		
	South Australia	*National Parks and Wildlife Act 1972*	Vulnerable		
	Tasmania	*Threatened Species Protection Act 1995*	Vulnerable		
Grey-headed Flying Fox *(Pteropus poliocephalus)*	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Vulnerable	Heatwave Bushfire Drought	Range extends from Bundaberg in Queensland to Melbourne in Victoria and from the coast inland to the western slopes of NSW.
	Victoria	*Flora and Fauna Guarantee Act 1988*	Vulnerable		
	New South Wales	*Biodiversity Conservation Act 2016*	Vulnerable		
	Australian Capital Territory	*Nature Conservation Act 2014*	Vulnerable		
	South Australia	*National Parks and Wildlife Act 1972*	Rare		
Other threatened woodland/grassland species	Grey Flacon *(Falco hypoleucos)* White-throated Needletail *(Hirundapus caudacutus)* Painted Honeyeater (*Grantiella picta)* Striped Legless Lizard *(Delma impar)* Golden Sun Moth *(Synemon plana)*			Drought Heatwave Bushfire Flood	Broadly associated with woodland and grassland ecological communities, varying in distribution (distribution notes for each species provided in Section 5).

Species	Jurisdiction	Legislation the asset is protected under	Conservation status	Extreme events and environmental disasters	Description of extent
	Hooded Robin *(Melanodryas cucullata)* Southern Whiteface *(Aphelocephala leucopsis)* Diamond Firetail *(Stagonopleura guttata)* Brown Treecreeper (southeastern) *(Climacteris picumnus victoriae)* Blue-winged Parrot *(Neophema chrysostoma)* Bald-tip Beard-orchid *(Calochilus richiae)* Small Purple Pea *(Swansona recta)* Turnip Copperburr *(Sclerolaena napiformis)* Purple Eyebright *(Euphrasia collina subsp. Muelleri)* Matted Flax-lily *(Dianella amoena)* Clover Glycine *(Glycine latrobeana)* Crimson Spider-orchid *(Caladenia concolor)* Euroa Guinea-flower *(Hibbertia humifusa subsp. erigens)*				
Other threatened floodplain/wetland species	Australian Painted-snipe *(Rostratula australis)* Sloanes Froglet *(Crinia sloanei)* Curlew Sandpiper *(Calidris ferruginea)* Mueller Daisy *(Brachyscome muelleroides)* Ridged Water-milfoil *(Myriophyllum porcatum)* Slender Darling-pea *(Swainsona murrayana)* Red Swainson-pea *(Swainsona plagiotropis)* River Swamp Wallaby-grass *(Amphibromus fluitans)* Winged Peppercress *(Lepidium monoplocoides)*			Drought Bushfire	Broadly associated with wetland or floodplain ecological communities, varying in distribution (distribution notes for each species provided in Section 5).
Other threatened montane/alpine species	Gang-gang Cockatoo *(Callocephalon fimbriatum)* Spot-tailed Quoll Dasyurus *(maculatus maculatus)* Southern Greater Glider *(Petauroides Volans)* Smoky Mouse *(Pseudomys fumeus)* Mountain Skink *(Liopholis montana)* Pilotbird *(Pycnoptilus floccosus)* Yellow-bellied Glider *(Petaurus australis)* Broad-toothed Rat *(Mastacomys fuscus mordicus)*			Bushfire Heatwave Drought	Broadly associated with either montane forest or alpine/sub-alpine ecological communities, varying in distribution (distribution notes for each species provided in Section 5).

Agricultural natural capital assets

Agricultural natural capital asset	Jurisdiction	Legislation and other relevant agreements and policies the asset is protected and managed under	Description	Extreme events and environmental disasters
Agricultural soils	Commonwealth	National Soil Strategy	Sets out how Australia will value, manage, and improve its soil over the next 20 years.	Bushfire Flood Drought
	Victoria	Strong, Innovative, Sustainable: A new Strategy for Agriculture in Victoria	A ten-year strategy documenting Agriculture Victoria's commitment to work with industry, community, and trading partners to ensure that the Victorian agriculture sector is strong, innovative, and sustainable.	
Riparian areas, Native Vegetation, Agroforestry and Environmental Plantings on Farms	Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999*	Provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, Ramsar sites and heritage places.	Bushfire Flood Drought
	Victoria	*Planning and Environment Act 1987*	Establishes the legal framework for planning use, development, and protection of land in Victoria.	
		Catchment and Land Protection Act 1994	Establishes Victoria's framework for the integrated management of catchments. Covers the classification and general control of noxious weeds and pest animals, establishing protections for primary production, Crown land, the environment, and community health from noxious weeds and pest animals.	
		Flora and Fauna Guarantee Act 1988	The key piece of Victorian legislation for the conservation of threatened species and communities and for the management of potentially threatening processes.	
		Guidelines for the removal, lopping and destruction of native vegetation	Incorporated into all planning schemes, focusing on the assessment and offsetting of native vegetation removal. The methods and approaches outlined in the Guidelines should be used to inform strategic planning processes and the application of appropriate planning controls to ensure Victoria's native vegetation is well managed and protected.	
Water	Victoria	*Water Act 1989*	Provides the legal framework for managing Victoria's water resources. The Act's main purpose is to: promote the equitable and efficient use of water resources, make sure water resources are conserved and properly managed for the benefit of all Victorians, and increase community involvement in conserving and managing water resources.	Bushfire Drought Heatwave

Agricultural natural capital asset	Jurisdiction	Legislation and other relevant agreements and policies the asset is protected and managed under	Description	Extreme events and environmental disasters
	Victoria	*Environment Protection Amendment Act 2018*	Provides the legal framework for the protection of human health and the environment from pollution and waste. The Act retains environmental reference standards (State Environmental Protection Policy objectives) as a core element of this framework.	
		State Environment Protection Policy (Waters)	Ensures Victoria has clear and relevant standards, legal rules, and statutory obligations to protect and improve the health of water environments.	

Bushfire Risk Assessment Data Share

Metadata Statement for External Clients

Bushfire Hazard and Risk Assessment

The Department of Energy, Environment and Climate Action (DEECA) assesses and quantifies bushfire hazard and bushfire risk using a sophisticated modelling framework. The framework uses multiple data inputs, processed data, data models, bushfire simulations and subsequent analysis. There are a range of outputs from the framework with an unlimited number of potential applications. This report provides information about one of those outputs, the 'bushfire hazard assessment', which may be used by external stakeholders and clients to undertake their own risk assessment against specific assets or values of interest. The 'bushfire hazard assessment' can be used to identify the relative hazard of bushfire in different locations. This product does not consider the likelihood of fires starting, or the exposure and vulnerability of assets that may be exposed to bushfires. This product represents the 'hazard' element in the risk equation and can be combined with asset exposure and vulnerability data to produce a risk assessment.

Assessment Settings

The fire behaviour simulations were conducted using Phoenix RapidFire, a computerised bushfire model used by Victorian and other state fire agencies including DEECA and the Country Fire Authority (CFA) to model the behaviour of actual and potential fires. To look at potential bushfire impacts, fires are simulated across Victoria from ignitions within each cell of a 2km grid across the state, which equates to more than 70,000 standard ignition locations across Victoria. Phoenix is used to run simulations and provides outputs at a 180-metre resolution.

The simulations use the worst-case weather and fuel scenario for your specific area. This includes local weather conditions of the worst fire danger day in the last 50 years (spatially interpolated from actual weather records). Local weather information is applied to each ignition location (one ignition within every cell of a 2km grid over the study area). The highest potential fuel load scenario was also used, which assumes no fuel management or wildfires have occurred, i.e., that all fuels are at their maximum load, therefore producing the most intense fire behaviour possible. Fuel type information is derived from Ecological Vegetation Class mapping. A summary of input parameters is available in Table 1.

Table 1. Summary of input parameters for bushfire hazard assessment

Parameters	Analysis Settings
Topography	Digital Elevation Model at 10m resolution
Ignitions	One ignition within each cell of a 2km grid
Specified Weather Scenario	Worst Forest Fire Danger Index (FFDI) day in the last 50 years for each ignition location
Fuel Type	Fuel type derived from Ecological Vegetation Class data
Fuel Status	Maximum fuel load (no fire history)
Simulation Resolution	180m grid
Simulation Extent	Statewide Victoria, no buffer
Outputs	180m grid with: - Cellid: Phoenix cell reference

	- Cmaname: Name of CMA - Max_intens: the maximum intensity recorded from all ignitions impacting the cell - Sum_intens: the sum of all intensities, from all ignitions impacting the cell - Count_inte: the number of ignitions impacting the cell - Max_inte_1: the percentile of the maximum intensity (relative to the catchment area) with 10=90-100th percentile, 1=0-10th percentile, NULL=no intensity impacts - Sum_inte_1: the percentile of the sum intensity (see max_inte_1) - Count_in_1: the percentile of the count of intensity (see max_inte_1)

** Phoenix RapidFire runs all ignitions simultaneously, with the assumption that none of these individual fires interact with each other. The sum of ignitions is therefore not a real measure of bushfire hazard but can be used to provide a crude ranking of locations that are more 'hazardous' than others, i.e., where the sum is highest.*

Outputs

Outputs from the bushfire hazard assessment are produced at a resolution of 180 metres and include a sum of the number of modelled fires that impact each 180m cell, a maximum modelled fire intensity, and a sum of all intensities impacting the cell.

Fire Intensity

Fire intensity is the radiant heat energy released by fire and is measured in kilowatts per metre (kW/m).

There are broad categories of fire intensity that relate to expected fire behaviour and suppression effectiveness:

- 3,000kW/m is the approximate upper limit where direct attack suppression can be successful, i.e., using equipment to directly attack the fire.
- 10,000kW/m is the approximate upper limit where a person sheltering in a vehicle could survive. Flames are typically up to 6m high. For intensities in this range (3,000-10,000), passive protection is possible, e.g., creating dozer lines, backburning/burning out away from the fire front.
- Between 10,000kW/m and 30,000kW/m, flames are typically 6-20m high. At this level, you could expect crown fires to occur.
- Above 30,000kW/m, a fully developed, intense crown fire is likely, with flames more than 20m high. Fuels, terrain, and weather can begin to combine and interact to reinforce intense fire behaviour.

DEECA considers a fire intensity of at least 10,000kW/m to be an intense fire; where damage to the tree canopy and impact to houses and other infrastructure is likely. Generally, grassfires have lower intensities and are unlikely to reach 10,000kW/m. Forest fires can exceed this threshold significantly, depending on the Forest Fire Danger Index, fuel loads, topography and other factors.

**The sum of intensity cannot be used to split data by intensity categories, as it is a function of intensity AND the number of ignitions impacting a cell. If you would like to explore categorisation of intensities, use the values in the maximum intensity column.*

Uncertainties and Limitations

Due to the unpredictable occurrence of bushfires, it is difficult to quantify the risks that they represent. DEECA has adopted a system that allows the simulation and assessment of many thousands of potential bushfires, without having to wait for real bushfires to occur. While this is useful, it is important to understand some of the assumptions and limitations of such a system. Some examples are described below:

- The outputs of Phoenix RapidFire simulations are modelled and may not reflect actual fire spread or intensity. Phoenix is one of several bushfire models currently available, each with its own strengths and weaknesses. Like all models, Phoenix gives only an approximation of reality. Phoenix is considered the most appropriate tool for bushfire modelling and analysis in Victoria at this time. Beyond bushfire simulations, there are multiple input layers and sub-models within the program, each of which can introduce errors and uncertainty in the modelled outputs. The model is sensitive to minor variations in

inputs. Small shifts in the weather, fuel accumulation functions, or time of ignition can cause variations in the results.

- Modelled bushfires are restricted to those that do their most damaging runs in a single day. The risk posed by multi-day bushfires (“campaign fires”) is explicitly excluded from the current analysis. The greatest losses of life and property in Victorian bushfires have historically been caused by severe single-day bushfires.
- Fires are ignited and simulated individually on a 2km grid across the State. That is, they are modelled to run independently of each other and do not interact.
- A full understanding of bushfire risk requires consideration of both the likelihood and consequence of bushfire impacts on human life, property and other values. The approach presented here considers the ‘hazard’ element of bushfire risk, and the likelihood of ignitions is explicitly ignored. In other words, in this analysis, all ignitions are equally likely to occur. We know historically this is not the case, with ignitions close to major roads and towns more likely to occur than remote areas. The likelihood of the weather scenario occurring, and the probability of suppression success are also not considered in the modelling. In built-up areas with early ignition reporting and short response times by emergency services, likelihood of suppression success may be much higher.
- The weather conditions used in this model are based on historic records of bad fire days. Thus, the outputs do not consider future climate scenarios where fire weather conditions are likely to differ from historic conditions.

Recommended Use of this Data

Depending on the type of analysis you are undertaking, there are many ways in which this data can be used to assess risk.

Intersecting this bushfire hazard information with the location, density or value of your assets of interest will add the necessary consequence measure to bushfire risk assessment.

Please contact the Bushfire Risk, Engagement and Predictive Services team for more information or assistance with the data provided.