BIODIVERSITY RESILIENCE STRATEGY

PROTECTING OUR BIODIVERSITY ASSETS

2024 – 2034

Biodiversity Team | Knox City Council

Version 1.0

FOREWORD

Mayor's Message

Our community has a strong connection to place, our leafy green natural environment and our waterways, with a long legacy of caring for Country through the traditional owners the Wurundjeri Woi-wurrung and Bunurong people.

Biodiversity protection and enhancement underpins a healthy environment that supports life, human wellbeing, cultural heritage and economic development.

All human endeavours rely on a diverse and functioning natural environment, which provides clean air, water and soil, and pollination, as well as amenity and cooling in a warming climate.

This strategy will endeavour to support a nature positive future where community co-exists with nature, protecting our Sites of Biological Significance and enhancing habitat corridors across the municipality to ensure our local wildlife can survive and thrive.

Council's bold tree canopy target of 30% by 2050 responds to the climate crisis ensuring a shaded oasis to assist in cooling our city, improving amenity and habitat connectivity.

In addition, the Strategy will work to incorporate cultural knowledge, through storytelling and recognising the Kulin Nation seasons.

We all need nature in the municipality, but we can't deliver this strategy alone.

Local community members, including local business, environmental volunteers and other community groups, all have a role to play to deliver this ambitious Biodiversity Resilience Strategy for the benefit of current and future generations.

Mayor Cr Jude Dwight

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INTRODUCTION

The Knox municipality holds a significant role in metropolitan Melbourne's biodiversity, providing key habitat connectivity between the eastern suburbs of Melbourne and the Dandenong Ranges. One of Knox's defining features is its leafy green feel, an aesthetic cherished by the community and one that offers valuable opportunities for engaging with the natural environment. The substantial involvement of dedicated volunteers within various environmental volunteer groups including Friends groups, Gardens for wildlife, the Knox Environment Society, and enthusiastic citizen scientists demonstrates the strong connection Knox's community has with biodiversity, and reinforces our commitment to initiatives that connect, protect, and celebrate biodiversity.

BIODIVERSITY CRISIS (Global/National/State/Local)

The significant and ongoing loss of biodiversity across Australia and worldwide has led to the local extinction of numerous indigenous species. This severe decline in biodiversity stems from a combination of factors. Among those relevant to the Knox municipality are land use change (urbanisation), the presence of invasive species (environmental weeds and pest animals), a lack of fire regimes for vegetation regeneration, and the impacts of climate change.

In Knox, biodiversity encompasses many species of flora and fauna, and ecosystems. Almost half of the local flora is locally threatened, as such it is imperative to protect local biodiversity for current and future generations. This includes maintaining healthy ecosystems, establishing connected habitat networks accessible to indigenous species, creating opportunities for local businesses to connect with the nature, and fostering an ongoing connection to Country and biodiversity stewardship.

Knox's natural environment is extremely fragmented due to residential and commercial development as well as supporting infrastructure such as roads. Council-managed bushland reserves are therefore an important part of the remaining network of natural habitat that provides food and shelter for a wide variety of wildlife, including many bird species, bats, frogs, reptiles, and insects. In addition, 47% of biodiversity in Knox sits on private land. This will require further consideration on how we protect biodiversity and tree canopy in these spaces to ensure liveability for future generations.

Council's approach to the biodiversity crisis focuses on collaborating with community groups, residents, local businesses, as well as local, state, and national governments and organisations. This ensures Knox's biodiversity remains resilient to threats and is protected for the future.

To achieve this, we utilise 'best-practice' methods on the ground and stay up-to-date with the latest biodiversity research. The management of pest flora and fauna requires consistency in long-term objectives, and we strive to do this by continuously improving the quality of our service and actioning long-term management plans.

This Strategy describes the current state of Knox's biodiversity and outlines the visions and goals for sustaining biodiversity resilience, a nature positive future and connection to Country over the upcoming decade. It does so within three primary focus areas: tree canopy and vegetation cover, habitat connectivity, and climate change resilience.

ACKNOWLEDGEMENT OF COUNTRY

We would like to respectfully acknowledge the traditional custodians of the Country on which we proudly care for, the Wurundjeri and Bunurong people of the Kulin Nation, and pay our respects to their Elders past, present and emerging.

TRADITIONAL OWNER'S MESSAGE

'Boorndup wan Dill-b-din – Respect and Protect'

We are born of the earth. We are people of the salt water and freshwater rivers and children of the Dreamtime. We walk in the footsteps of our ancestors and protect our environment so it can continue to protect us. It provides us with vital food sources and healing waters and supplies us with generous shelter and hunting grounds. We only take what we need and never waste, we always leave enough vegetation for regrowth and fish in the waterways to replenish. This is to keep the natural balance in Country so our creatures and animals may survive too.

All Aboriginal people are born with a totem. They are handed down over thousands of generations and specific to each Clan according to where their Country is. We are taught we must never harm or eat our totem, but to always respect and protect it. In turn, our spirit totem will watch over us and speak to us in the spiritual sense to keep us safe.

The traditional language of the Wurundjeri People is Woi-Wurrung. In the Woi-Wurrung language, the word Wurundjeri is in two parts: 'Wurun', meaning the manna gumtree, and 'djeri', meaning the white grub that lives in the tree - the witchetty grub. The gentle floating gum leaves represent Wurundjeri Country and the lush green eucalyptus trees that house our native fauna.

Simone Thomson

Wurundjeri, Woi-Wurrung / Yorta-Yorta

DEFINING BIODIVERSITY

Biodiversity refers to the variety of life found on Earth and includes the flora, fauna, fungi, insects, and microscopic organisms that share our planet with us. It is the natural environment around us and is fundamental to the health and wellbeing of all life on Earth. Across the state of Victoria, biodiversity is in decline with more than half of Victoria's vegetation being cleared since European settlement. Numerous flora and fauna species are at risk of local extinction, primarily due to a range of pressures, including the impacts of climate change and habitat loss. At Knox City Council, the biodiversity service is specifically focused on the protection, enhancement, and celebration of indigenous and native flora and fauna and their habitats.

In 2017, the Victorian Government launched the *Protecting Victoria's Environment - Biodiversity 2037* plan that presents a long-term vision for Victoria's biodiversity to be healthy, valued, and actively cared for. The protection of biodiversity is paramount to ensuring healthy, liveable communities, and is a key priority for Knox City Council.

Council aims to uphold this vision through its extensive work in the biodiversity space, which includes:

- The current revision of the Sites of Biological Significance study 2010
- Developing long-term objectives and action plans.
- Utilising contemporary best practices in the field to protect and enhance bushland reserves and biodiversity.
- Undertaking pilot research projects to incorporate science and natural resource management (e.g. revegetation climate plots and hollow enhancement program).
- Collaborating with local environmental volunteers and community groups to undertake biodiversity works, research and monitoring.
- Promoting awareness of biodiversity in the community and encouraging stewardship.
- Protecting and enhancing biodiversity on private land.

WHAT IS BIODIVERSITY RESILIENCE?

Biodiversity resilience is the ability of species, ecosystems, or processes to thrive during a state of relative instability. It involves the capability to change and adapt in response to natural environmental stressors and anthropogenic disturbances. Biodiversity resilience in urban areas attempts to increase the bio-resilience and liveability of cities.

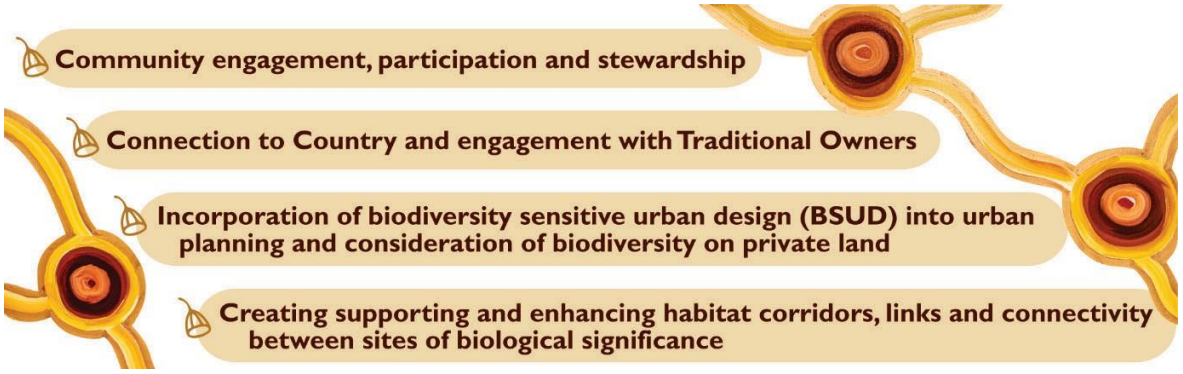
An ecosystem's ability to be resilient is dependent on several factors:

- Location within the broader landscape
- Species diversity and variation in responses to disturbances
- Connectivity between larger habitat areas
- Current health of biodiversity
- Available habitat area (size and quality)

For each species that contributes to the same ecosystem function, its ability to respond in a diverse manner to natural and anthropogenic human change can alter an ecosystems vulnerability. As particular species or species guilds (group of species with similar traits) provide unique ecosystem functions, actions to restore resilience should focus on particular species or functions for landscape and urban biodiversity management.

The healthy state of all components is essential for the maintenance of urban bio-resilience. Urban ecosystems are commonly comprised of small bushland remnants, pocket parks and roadside reserves that are particularly important in maintaining ecosystem connectivity and biodiversity resilience within the residential and industrial matrix of the Knox municipality. Of the 122 Council-managed bushland reserves in Knox, many are tucked-away inconspicuously in streetscapes yet still provide critical habitat for the region's native flora and fauna and are managed to ensure the enhancement of biodiversity.

Knox recognises that the following components are essential to successfully create biodiversity resilience in urban areas:



LANDSCAPE OF KNOX

The Knox municipality is uniquely positioned on the urban-rural fringe to the east of Melbourne. It encompasses a blend of residential and industrial land uses, complemented by expansive rural and conservation areas that encompass National Parks and waterways. Nestled in the foothills of the Dandenong Ranges, Knox supports important and significant tracts of land that provide habitat to a diverse array of Indigenous flora and fauna. The municipality is within the Gippsland Plain and Highlands Southern Fall Bioregions and Port Phillip and Westernport Catchment. Furthermore, Knox rests on the traditional lands of the Wurundjeri and Bunurong Peoples.

The key bio links comprise the three main waterways (Dandenong Creek, Blind Creek and Corhanwarrabul Creek), extensive areas of National Park and reserves to the east and south-east, and regions characterised by relatively high canopy cover, notably around The Basin and Boronia. Additionally, there are numerous other connectivity zones and secondary linkages that feed into these zones right across the municipality.

The fauna of Knox is dominated by urban species found in many Melbourne municipalities. However, the proximity of Knox to the Dandenong Ranges enhances fauna diversity. Common fauna within Knox include Ringtail and Brushtail Possums, Sugar Gliders, Feathertail Gliders, Blue Tongue Lizards, Crimson and Eastern Rosellas, and Sulphur Crested Cockatoos. In addition to these common species, Echidnas, Platypus, Swamp Wallabies, Bush Rats, Bats, Black Cockatoos, Powerful Owl, Blue-billed Ducks, Falcons, and Gang Cockatoos are also frequently observed.

The Dandenong Foothills in the east of Knox is highly valued by the local community for their aesthetic appeal and for giving Knox its unique bushland feel. This unique landscape setting provides a strong cultural, social, and environmental reference point for residents who take pride in, are deeply connected to, and actively enhance the natural environment and its associated values.

REGIONAL CONTEXT

Knox occupies a pivotal transition zone, serving as a link connecting Melbourne's urban landscape with the vegetated hillsides of the Dandenong and Yarra Ranges. The municipality's topography has influenced the extent of its development with primarily flat areas in the west, gradually transitioning to undulating hills and steeper slopes towards the Dandenong Ranges in the east. Detailed description of the geology, rainfall and vegetation communities within these bioregions is given in extensive detail in The Sites of Biological Significance report 2010. Within Knox, a diverse array of larger natural and semi-natural landscapes exists, interspersed with smaller bushland reserves and various forms of public open spaces that are dispersed throughout the residential and industrial landscape. Significant natural landscapes include the Lysterfield Valley and Lysterfield National Park, Dandenong Ranges National Park, Churchill National Park, and the Dandenong Creek Parklands. These natural areas are ecologically and socially significant at both regional and local levels.

LEGISLATIVE CONTEXT/ROLE OF COUNCIL

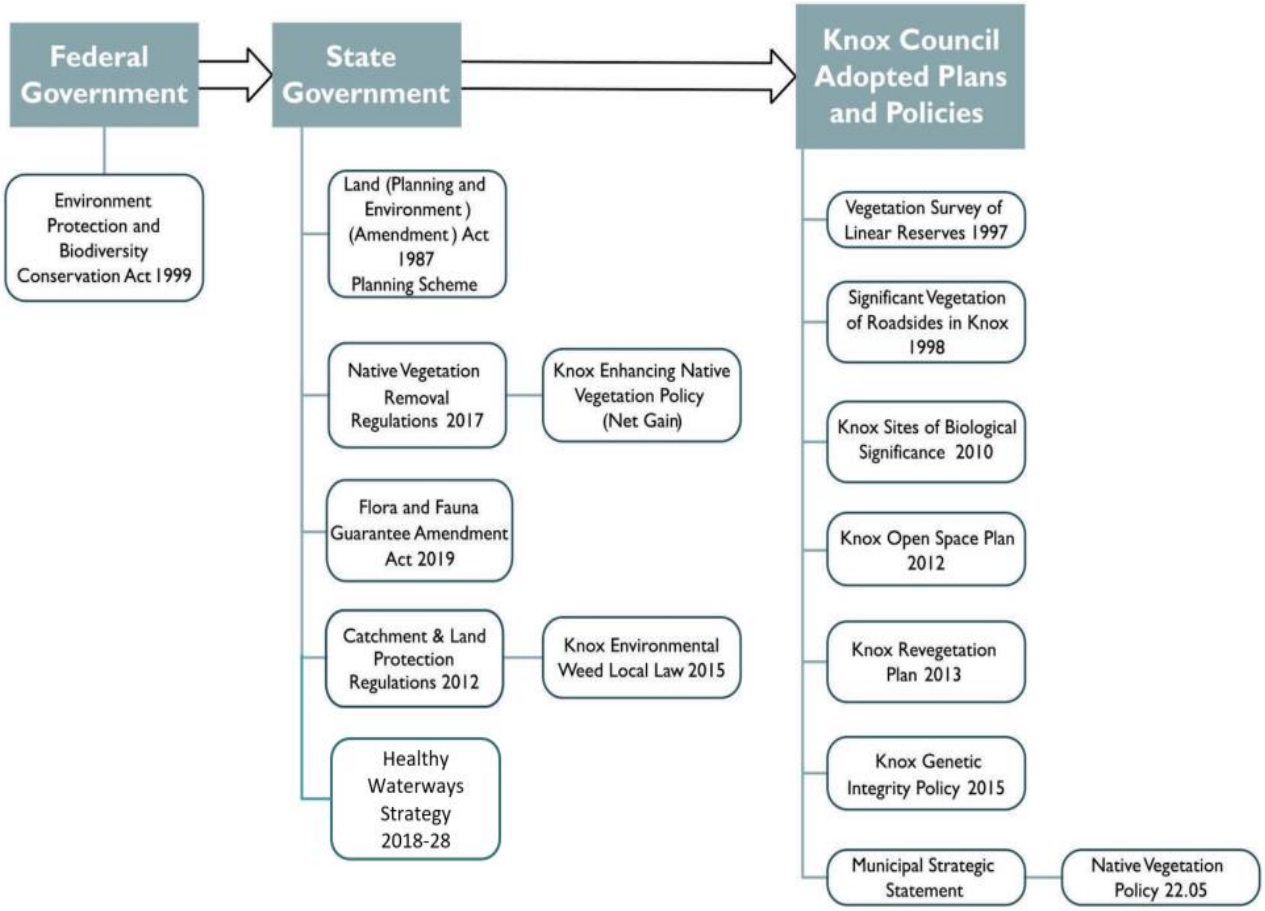


Figure 1. Regulations directing biodiversity protection

THREATS TO OUR ENVIRONMENT

Climate change and extreme weather events pose a significant threat to biodiversity. Increasing temperatures, shifting rainfall patterns and heightened occurrences of severe weather events can lead to several adverse impacts on biodiversity. These include habitat loss, faunal casualties, reduced 'functional biodiversity' (ability for fauna to move for food, breeding, and protection), reduced long-term survival, and the species resilience to disease. In 2022 Knox City Council declared a climate emergency that recognizes the threat to biodiversity and formally enables Council to action activities to mitigate the effects of climate change.

Habitat loss and fragmentation from residential and commercial development, agricultural land use, and infrastructure construction (such as roads and community facilities) alters the functioning of ecosystems, and reduces the available vegetation used by wildlife for habitat (such as tree hollows), food resources and movement.

BIODIVERSITY VISION

Invasive flora and fauna species displace Indigenous species, contribute to land degradation, and reduce the food and habitat availability for wildlife. It also threatens the resilience of remnant vegetation that supports ecosystem health and gives Knox its 'sense of place'. Specific invasive species of concern in Knox are also common across south-eastern Victoria and include deer, foxes, blackberries, and Ivy.

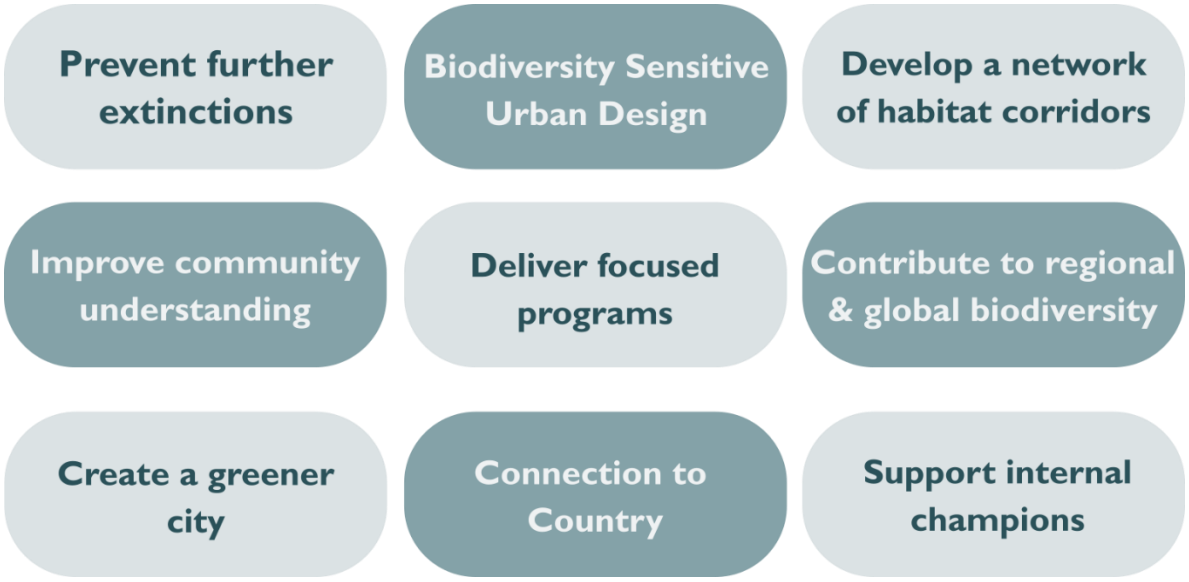
The native flora, fauna and ecosystems of Knox create a thriving and resilient natural environment in which the community coexists in working towards a nature positive future.

In addition, we strive for:

- Healthy connected communities, with people working jointly toward the goals of protection & enhancement of biodiversity and habitat connectivity.
- People feeling physically, spiritually, and emotionally connected to their neighbourhood through greater connection to nature, and environmental stewardship.
- Partnerships between levels of government, the private and not for profit sectors that deliver innovative solutions to complex issues and support a nature positive future.
- Sustainable living within all sectors of the community, where the norm is using energy and water conservatively, minimising waste creation to care for the natural environment.

- The support, protection, and enhancement of biodiversity, including rare and threatened species.
- Knox caring for their biodiversity values and supporting a nature positive future.

BIODIVERSITY GOALS



Prevent further extinctions of flora, fauna, or ecological vegetation classes in Knox.
Populations of Indigenous species in Knox are under threat from habitat destruction, drought, and other threats. In certain instances, such as with the platypus, local populations have plummeted to unsustainable levels and could result in the local extinction of platypus. Knox also provides habitat for species that are threatened and vulnerable within the broader region, such as the gang-gang cockatoo. Reducing the likelihood of extinctions in Knox requires active habitat protection and controlling threats that impact species both residing in Knox and those for which Knox provides a crucial portion of their habitat. Work will also be required to identify species that are most likely to be seriously affected by changes in climate.

Develop and implement approaches and systems that ensure Biodiversity Sensitive Urban Design principles are adopted throughout Council.
Biodiversity Sensitive Urban Design (BSUD) represents both an approach and a methodology aimed at overseeing current urban infrastructure and guiding the planning, design, construction, and ongoing operation of forthcoming urban infrastructure. By implementing BSUD principles within capital funding projects and integrating them across the spectrum of Council projects, we will ensure that biodiversity resilience in Knox is maintained into the future, particularly within the context of climate change.

In addition, consideration of biodiversity in scoping and design of Council built facilities would support the opportunity to gain five Green Star rated buildings.

Establish a network of habitat corridors to join sites of significance with other areas of Indigenous vegetation.

Knox has undertaken and is currently in the process of revising the Sites of Biological Significance Study. This study maps out locations within Knox that hold exceptional biodiversity value. Protecting these sites from unsuitable development is of utmost importance to their preservation and this has been facilitated by establishing a connection between these significant sites and the Knox planning scheme. Maintaining existing habitat corridors and developing new ones is critical in connecting the remaining habitat patches which local wildlife depend on for feeding, breeding, and shelter.

Improve community understanding of the importance of biodiversity and the role they can play in its conservation and protection.

Many community members are unaware of the ways in which their day-to-day activities may have an impact on biodiversity, or of the importance of well- functioning ecosystems in sustaining life. Concurrently, there exists a collective desire to make environmentally responsible choices, albeit without clear guidance on how to do so. Improving Council education programs and campaigns will serve as a valuable platform for imparting practical advice and enabling people to actively participate in biodiversity conservation efforts. This includes Council developing a greater understanding of community's values around biodiversity.

Deliver focused programs for control of pest fauna and flora on private and public land.

A variety of introduced predators, such as foxes, rabbits, deer, and cats, pose significant threats to Indigenous flora and fauna. In urban areas, domestic animals, especially, become a specific concern. Additionally, environmental weeds exacerbate the challenges faced by local ecosystems. Notable species vary from one region to another; within Knox, particularly problematic ones (but not limited to) include Sweet Pittosporum, Blackberry, Cotoneaster, Angled Onion, Sweet Vernal-grass, Asparagus Fern, Large Quaking-grass, Greater Bindweed, Red Cestrum, Boneseed, Hawthorn, Montbretia, English Broom, Ivy, and Sallow Wattle. Several programs, including Gardens for Wildlife, Nature Stewards, Friends Groups, and citizen science initiatives, play pivotal roles in addressing the control of pest fauna and weeds. These programs actively engage community members, local businesses, and the Council. Notably, Knox is a leading participant in the Eastern Region Pest Animal Network, which collaboratively developed the Pest Animal Strategy adopted by the Knox Council in 2019.

Contribute to regional and global biodiversity working with regional partners.

Knox is part of the Port Phillip and Westernport catchment region, which spans the catchments of Port Phillip and Westernport Bays.

The water ways, soil, geology, flora, fauna, and atmosphere of Knox are directly connected to those of neighbouring municipalities and the larger region. Improving biodiversity outcomes in Knox requires consideration of this broader context and on-going cooperation with current and future organisations including Living Links, Gardens for Wildlife Victoria, Eastern Region Pest Animal Network, and the Vegetation Climate Resilience Grant Partnership to work towards shared goals.

Create a greener city with more trees and Indigenous vegetation in public spaces and thriving emblematic species.

Healthy ecosystems with flourishing biodiversity are typically more enjoyable environments for people. Most people find flora and wildlife aesthetically pleasing and relax when in nature. Extensive research indicates a compelling connection between community well-being, the availability of green spaces, and the proximity to natural settings. While exceptions certainly exist, the enhancement of biodiversity conservation within Knox offers a valuable opportunity to elevate the overall appearance, atmosphere, and liveability of the region.

Survey results consistently demonstrate the Knox community highly value the natural environment, bushland reserves and native wildlife.

Fostering a connection to Country.

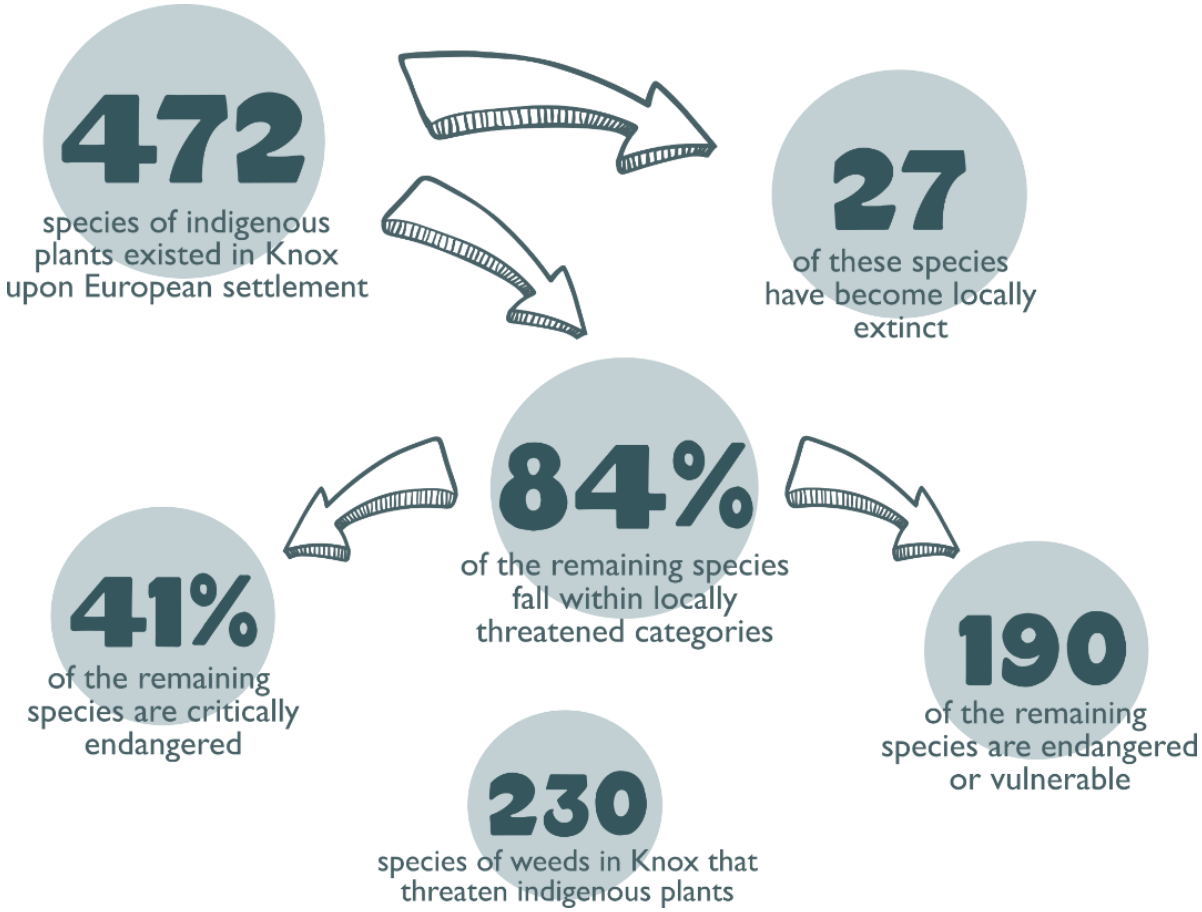
Knox recognises that a thriving resilient natural environment is only possible when a meaningful and ongoing connection to Country exists. Through our biodiversity vision, goals, and the actions we take for maintaining biodiversity resilience, we will ensure that Indigenous culture and knowledge is always incorporated and represented in our biodiversity practice. The incorporation of Indigenous stories and seasons as a vehicle for reconciliation, truth-telling and healing of Country will help acknowledge Knox's Aboriginal heritage and create exciting biodiversity conservation actions that engage community and inspire action.

Facilitating internal biodiversity champions.

Provide opportunities and support for Knox City Council staff to connect and engage in biodiversity activities. This includes facilitating staff to participate in the annual Business National Tree Day, encouraging internal groups to consider biodiversity issues and goals, and encouraging staff to participate in public biodiversity campaigns such as Biodiversity month and City Nature Challenge.

STATUS OF KNOX

In 2010, Knox undertook a study regarding Sites of Biological Significance within the municipality, which identified 118 sites containing remnant Indigenous vegetation. These include several significant bushland areas which are managed as conservation zones. As remnant vegetation becomes more fragmented, it results in habitat quality decline. It is a key priority for Knox to ensure the protection of these biologically significant sites.



WHAT WILL THIS STRATEGY DELIVER?

Project 1	Project 2	Project 3
Mapping Analysis Study	Biodiversity Resilience Study	A Climate Resilience Tree Framework
Knox Council Mapping and Research	WSP Consultants	Dave Kendall – University of Tasmania
Mapping the Extent and Change of Tree Canopy Cover in Knox	*Chapter 1.* Emblematic Species	A Climate Resilient Tree Framework for Knox City Council
	Chapter 2. Land Acquisition Framework	
	Chapter 3. Habitat Connectivity Mapping	
	Chapter 4. BSUD Planning Approach	

This Strategy outlines the priorities for biodiversity within Knox City Council over the next decade (2024-2034). This will allow Council to set targets and ensure that areas identified as key biodiversity zones are managed effectively to ensure protection of their ecological significance. The Biodiversity Resilience Strategy will enable Council to provide greater support to environmental volunteers, while also facilitating the identification of opportunities for securing external funding. Moreover, it will establish a framework to ensure ongoing monitoring and adaptive management as integral components of Knox's overarching biodiversity strategy.

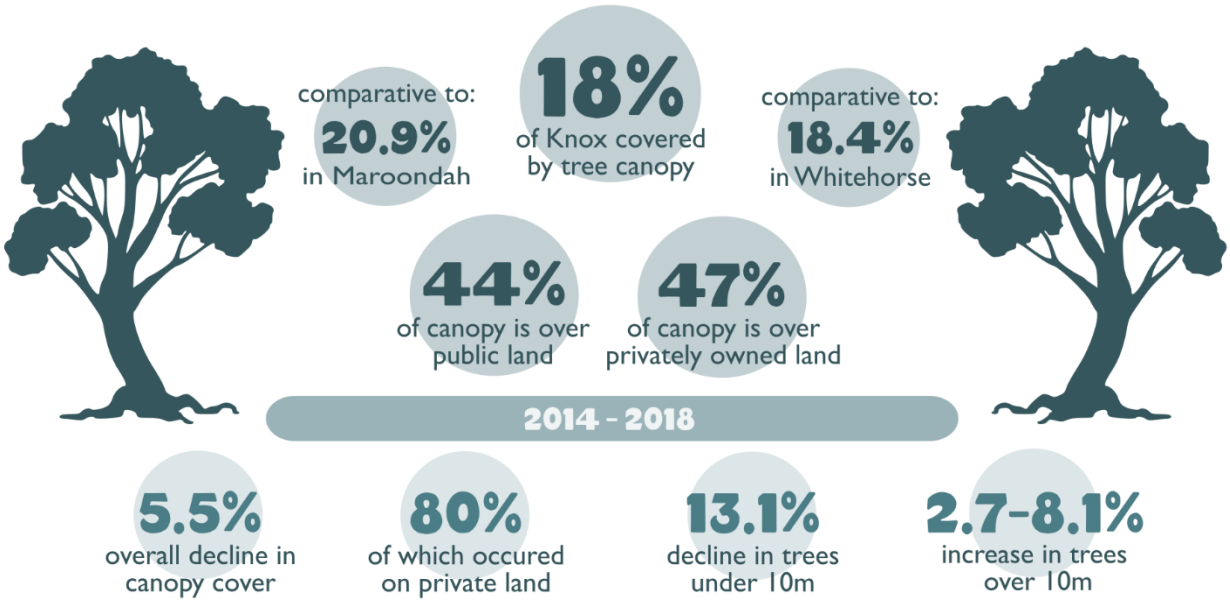
This Strategy supports a suite of programs, activities and initiatives that will continue to protect and enhance our natural environment and create a more resilient habitat for indigenous flora and fauna.

BIODIVERSITY RESILIENCE STRATEGY PROJECTS:

Project 1: Mapping Analysis

Knox City Council conducted a mapping analysis regarding the extent and change of tree canopy cover across the Knox municipality. The purpose of this analysis was to inform the Biodiversity Resilience Strategy and support Knox's tree canopy cover target of 30%. More broadly, the analysis assists with strategic planning of the municipality as well as planning and budgeting for revegetation projects and priority conservation areas.

Part of the study included a benchmark study to identify the vegetation monitoring practices of surrounding Councils (Boroondara, Kingston, Maroondah, Monash, Whittlesea) to determine the best method for canopy cover analysis. Aerial photography, LiDAR and colour infrared images were found to be efficient, cost-effective, and reproducible over subsequent years for comparison. Councils used varied approaches to locate trees and estimate canopy cover using tools including manually pinpointing tree locations and utilising machine learning and artificial intelligence.



The decline in total tree canopy cover has been concentrated in the northern suburbs of the municipality, particularly in Wantirna, Boronia, Ferntree Gully, and Scoresby. In residential areas, this decline is specifically concentrated to the north and northwest of the Westfield shopping centre. Both private and public land types show this decline, however public land in these areas mainly consists of streetscapes rather than parklands, so this might be explained by housing developments in these areas. Historically, the decline in the northern suburbs aligns with long-term land conversion from native trees to urban and built-up areas since the late 1980s.

Canopy cover change has been mixed near Sites of Biological Significance and in areas where rare and threatened species occur. Specifically, with the help of Councils extensive revegetation program, there has been notable increases in canopy cover of between 5-20% at biologically significant sites including Koolamara Waters, Heany Park, Wally Tew Reserve and Napoleon Road Linear Reserve. Despite this, in surrounding residential areas of Sites of Biological Significance there has continued to be a decline - particularly around Old Joes Creek, Koolunga Native Reserve, and Bateman Street Reserve, which hold some of Knox's most sensitive and significant remnant patches of bushland.

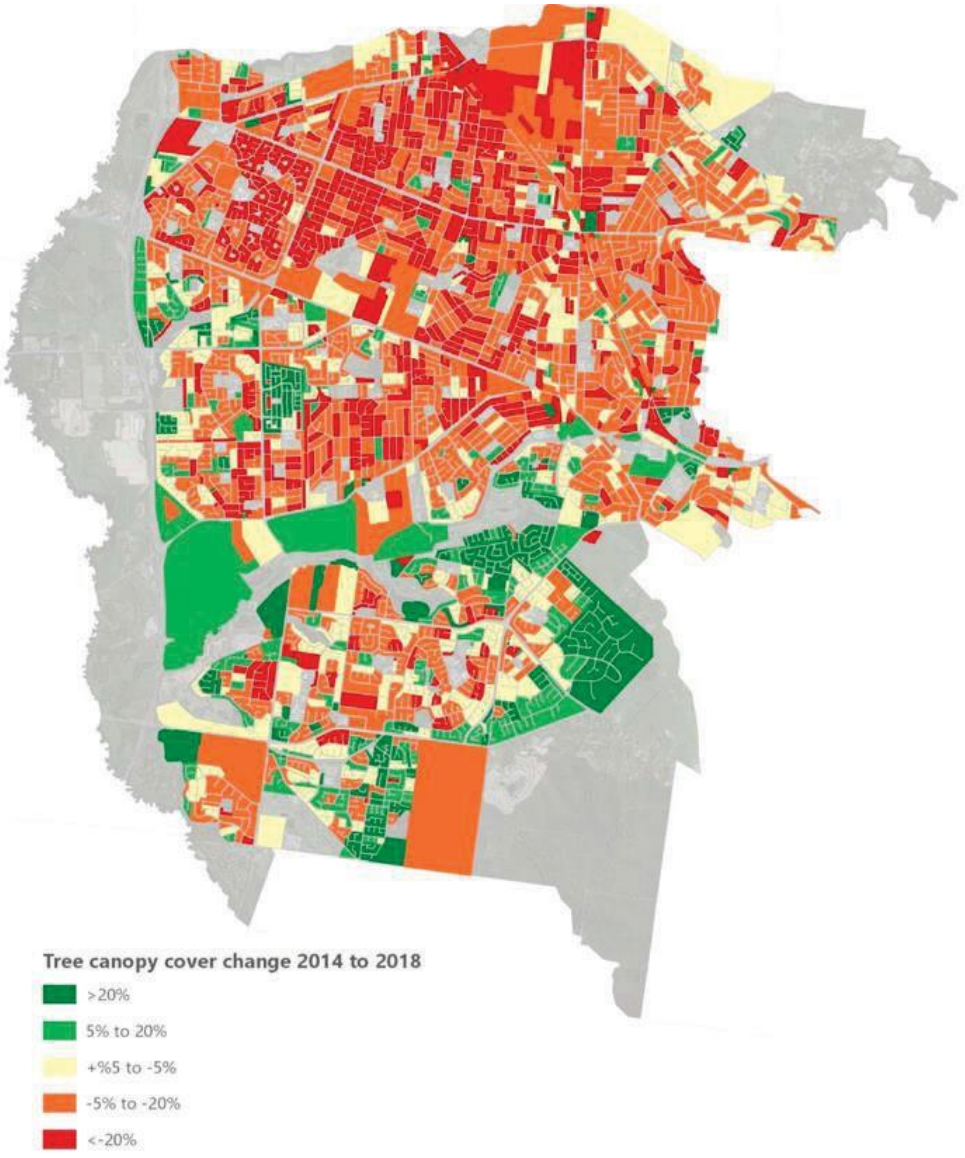


Figure 2. Tree canopy cover change 2014-2018 on private land (residential, industrial, and commercial)

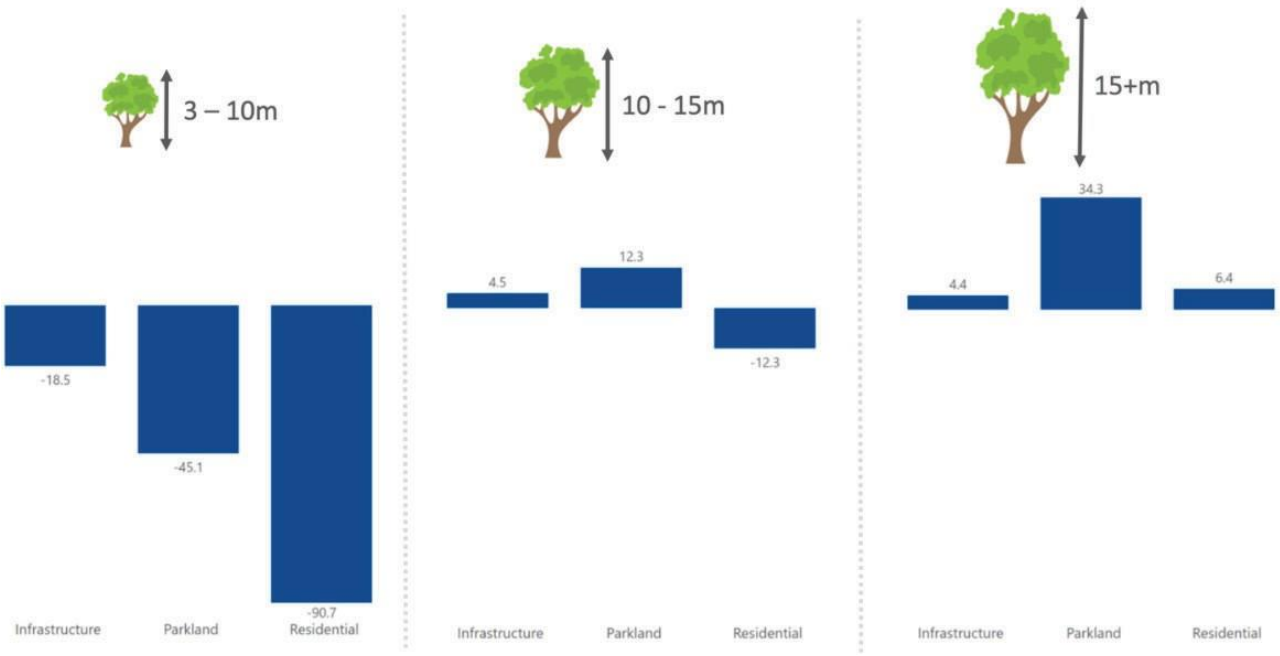


Figure 3. Canopy cover change across different land tenure and tree size.

Concerningly, there have been consistent declines in canopy cover (5-20%) (predominantly on private land) across The Basin and the western edges of Boronia and Ferntree Gully – areas that provide key habitat connectivity and facilitate wildlife movement into the Dandenong ranges. The data used in this analysis considers the change in vegetation extent between 2014 and 2018. There have since been revisions of this dataset with indications that DEECA intends on updating this type of vegetation data on a regular basis.

Key recommendations:

- Work with internal, external, and residential stakeholders to achieve 30% tree cover by 2050. Internally, this will involve policy, statutory and strategic planning, operations, community engagement and business support teams. Concert energy towards reducing the canopy decline on private land.
- Explore and establish a means of mapping canopy regularly in order to establish success of canopy increase.
- Set Council incremental canopy milestones in the lead up to 2050 target of 30% canopy.
- Ensure small trees and newly vegetated areas are prioritised to ensure they become established and resilient.
- Review how vegetation is protected on private property to reduce the opportunity of canopy cover loss and how community campaigns can support vegetation management.
- Explore how local laws can contribute to reducing environmental weeds on private property that reduce the vegetation cover of Indigenous species.

- Continue and improve community engagement and education campaigns to improve public perception towards trees.
- Review the methodology of calculating Knox's tree canopy cover and verify how to incorporate and compare the findings of this analysis with future datasets, analyses, and monitoring objectives.
- Gain greater understanding of community values around trees in order to develop targeted campaigns and education.

Project 2: Biodiversity Resilience Strategy Study (4 Chapters)

Knox City Council commissioned ecological consulting firm WSP for the Biodiversity Resilience Strategy Study to identify and strategically plan for the protection and enhancement of biodiversity values across the municipality. The study included four discrete components:

1. Identify a suite of emblematic species to enhance community engagement outcomes and inform conservation actions,
2. Develop a framework to guide Council staff when making decisions about the acquisition of land for conservation outcomes,
3. Conduct an analysis of Knox's habitat connectivity and identify gaps in the network that offer the best opportunities for conserving biodiversity and facilitating the movement of wildlife across the municipality,
4. Investigate best practise in Biodiversity Sensitive Urban Design (BSUD) to incorporate into future developments and projects in Knox.

Chapter 1 - Emblematic/focal species

Following a series of online community surveys and workshops with internal and community stakeholders it was clear that stories which integrated species and places was key for effective and long-term engagement with the community for conservation actions. Wurundjeri and Yorta-Yorta woman Simone Thomson was an integral participant in this process and told the story of Aboriginal people being born with a totem that is handed down over thousands of generations and specific to each clan. There was consensus that the inclusion of emblematic species and stories should come from a base in Knox's Indigenous culture (Wurundjeri Woi Wurrung and Bunurong people of the Kulin Nation), and that the use of Indigenous seasons would be an ideal framework for creating conservation action programs. A list of 27 'emblematic' species that represented a range of habitat uses and movement typologies in Knox was compiled based on the responses to the community consultation (Appendix 1).

From this list, and in consultation with data from the habitat connectivity matrix of the connectivity plan, a selection of five species were chosen to be Knox's 'focal' species.

'Boroin', the superb fairy wren, 'bullum-bullum', the butterfly, 'tadjerri' the sugar-glider possum, 'ngarrert', the frog and 'gawarn' the echidna each exist in harmony as they have done since the time of Bunjil's creation. Each represents their ongoing presence and connection to Country and their importance to the balance of nature within the traditional seasons. They represent their ongoing survival and place on Country and their existence in the totem world (Simone Thomson).

Figure 4. The final five focal species chosen to represent Knox and for use within the Biodiversity Resilience Strategy.

Presenting these stories and emblematic/focal species with Indigenous seasons as a framework would provide space for:

1. reconciliation, truth-telling and hearing and healing Country,
2. creating exciting conservation actions to engage the community,
3. representing Country, culture, and connections ("Country is connectivity"),
4. utilising emblematic and focal species to inspire action,
5. incorporating Indigenous bio-culture for more effective conservation outcomes,
6. stories to connect the Knox landscape and Songlines to create a sense of place.

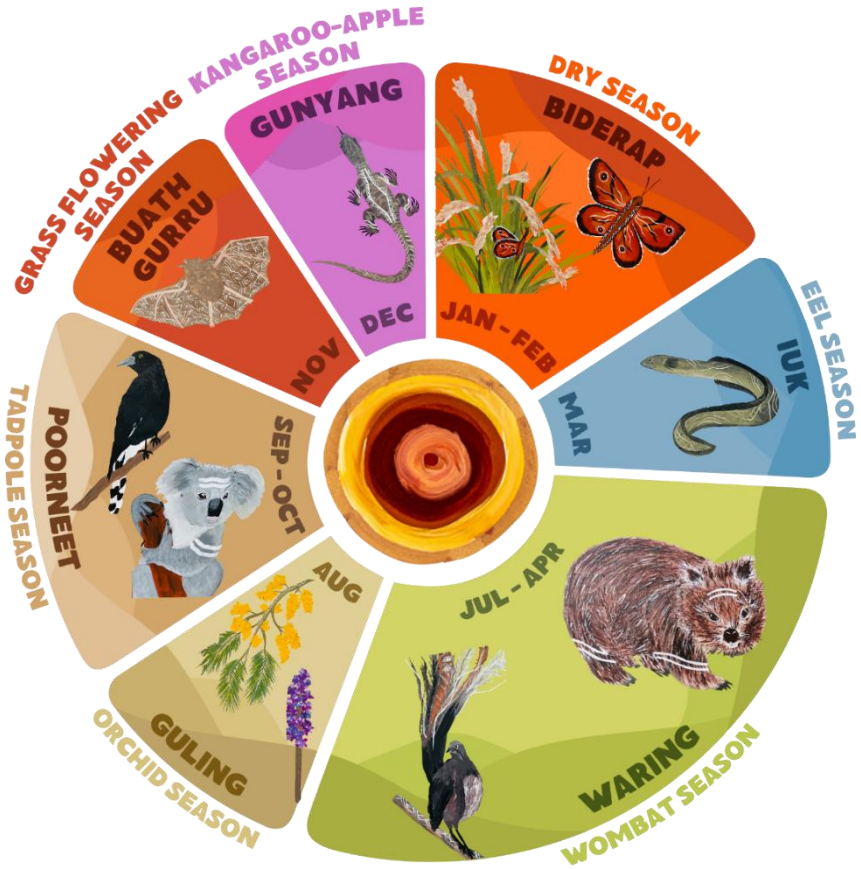


Figure 5. The Seven Seasons of the Kulin People, featuring artwork by Simone Thomson.

Key recommendations from this phase of the project are:

- Undertake further consultation with the Indigenous community to identify and develop seasonal stories.
- Adopt the seven seasons of the Kulin Nation as the basis for emblematic species, stories, and Country.
- Use emblematic and focal species and stories to inform Council actions and engage with the community to undertake on-ground actions on public and private land to improve biodiversity health, resilience and coexistence with nature.
- Prepare and implement a detailed action plan that describes the stories, engagement methods and resources to achieve biodiversity resilience in the City of Knox, with the ambition to strive for a nature positive community.

Chapter 2 - Acquisition

The conservation of biodiversity in urban and suburban landscapes is a high priority for land managers, including Knox City Council. There are numerous parcels of land within the municipality that occur outside the formal or protected reserve system, but which still contribute to the conservation of biodiversity and habitat connectivity.

Opportunities to acquire these locations occasionally arise (e.g. Bateman St Bushland, VicTrack land) triggering a response by Council to assess the current, future, and potential benefits to biodiversity at the specific location and across the municipality (e.g. connecting fragmented habitat corridors). The acquisition framework provides a transparent, objective and evidence-based approach to evaluate the costs and benefits of acquiring land to strengthen the resilience, viability, and connectedness of the biodiversity system. This ultimately ensures that assessment methods and formal decision-making is actively geared towards positive ecological outcomes through habitat provision and enhanced ecological connectivity.

There are four phases to the framework guidance:

1. a rapid appraisal to shortlist potential sites and determine if a site warrants further assessment,
2. undertake a site-specific screening to identify any major issues or concerns,
3. undertake a comprehensive biodiversity assessment to score and rank the value of the site for conservation,
4. further considerations to identify additional values that may support the acquisition.

Chapter 3 - Connectivity

The movement of wildlife, flora and ecosystem processes is critical to biodiversity conservation and the health and functioning of ecosystems. Ecological connectivity is the ability of species to freely move through a landscape and the arrangement of landscape elements that facilitate or impede such movement. Improving ecological connectivity is particularly important in urban environments where species often face increased levels of habitat fragmentation and novel habitat types (major roads) that need to be negotiated while moving.

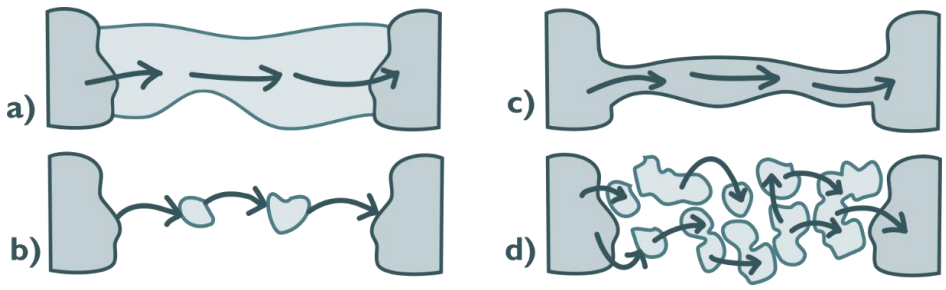


Figure 6. Different ways in which landscape connectivity can be achieved. (a) continuous habitat is maintained within a landscape; (b) stepping stones of different size or spacing along a mostly linear route where animals must cross unsuitable areas; (c) continuous corridors of varying width which provide an uninterrupted link between two larger patches of habitat, and (d) is where the intervening matrix has sufficient 'habitat' to allow wildlife to persist within the matrix as well as move between larger patches of habitat.

In Knox, key biolinks include the three main waterways (Dandenong Creek, Blind Creek and Corhanwarrabul Creek), the large areas of National Park in the south-east of the municipality, and areas with relatively high canopy cover, such as around The Basin and Boronia. The existing ecological connectivity of habitat patches was assessed using an overall metric of connected habitat area (effective mesh size in hectares) for the five chosen focal species; Sugar Glider, Marsh frog, and Short-beaked Echidna, Australian Admiral Butterfly, Superb Fairy-wren. The study identified the location of connected habitat patches for each species, and connections and gaps or barriers to movement and suggested priority areas for focused effort by Council to maintain and enhance ecological connectivity within Knox.

Species	*Total area of habitat*	*Number of connected areas*	*Effective mesh size (i.e., connected areas)*	*Proportion of available area to species*
Sugar Glider	505.4 ha	587	25.9 ha	5%
Striped Marsh Frog	305.2 ha	45	45.4 ha	15%
Echidna	1680.1 ha	188	314.5 ha	19%
Aus. Admiral Butterfly	1536.1 ha	153	334.4 ha	22%
Superb Fairy Wren	1481.0 ha	168	336.5 ha	23%

Figure 7. Overview of habitat connectivity analysis for each of the focal species.

Key recommendations from this section of the report include:

- Identify locations where habitat is contributing to ecological connectivity for many species.
- Identify opportunities to improve landscape level ecological connectivity (e.g. south of Napoleon Road, Lysterfield, and Bayswater industrial area).
- Refine the boundaries of connectivity zones so they follow natural ecological boundaries and explore opportunities to formally recognise connectivity zones through the Planning Scheme and other mechanisms.
- Identify and map 'secondary' linkages and stepping-stones that connect connectivity priority areas (e.g. roadside reserves, tributaries that drain into major waterways, private land parcels, and other patches of vegetation).
- Develop a biodiversity action plan for each connectivity corridor to ensure operational activities are relevant and suited to specific connectivity corridors.
- Identify and restore missing connectivity network links through habitat restoration, installation of wildlife crossing structures, working with private landowners (e.g. through Gardens for Wildlife) and other BSUD methods.

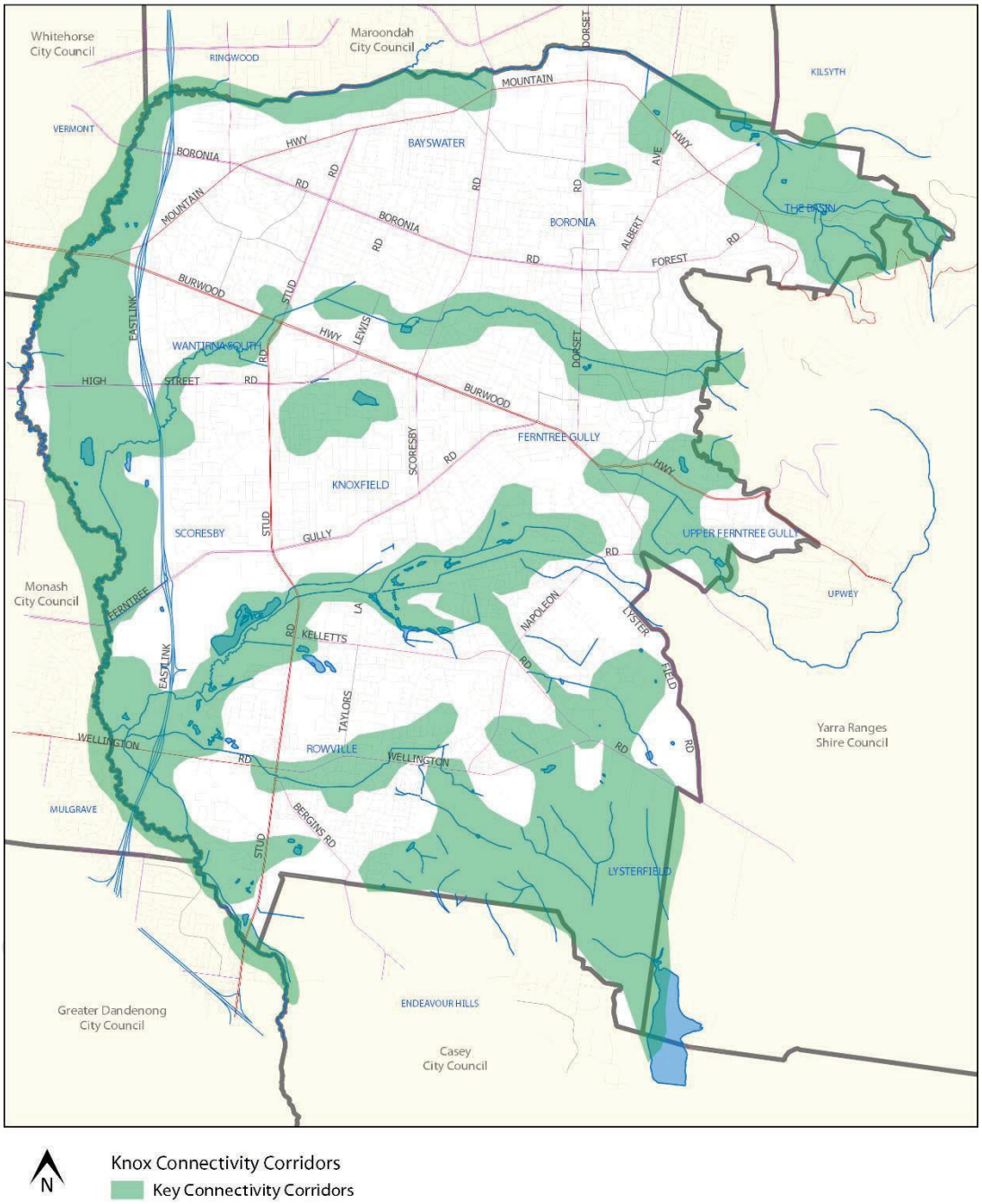


Figure 8. Map showing ecological connectivity corridors within the City of Knox.

Chapter 4 - BSUD Design

Biodiversity Sensitive Urban Design (BSUD) is an approach and methodology to scope plan and design and construct future urban infrastructure to support the conservation of biodiversity and enhancement of ecosystem health and services. This section of the report provides guidance on protecting, enhancing, and restoring biodiversity in urban and peri-urban spaces and offers design principles for Council to apply across numerous projects to improve urban biodiversity outcomes across multiple land tenures including residential, roadsides, waterways, industrial areas, and existing and proposed developments.

Key recommendations from this section of the report include:

- Provide simple and easy to use resources for community to understand BSUD and be encouraged to adopt these on private land (specifically via supporting the Gardens for Wildlife program to promote BSUD more widely across the municipality).
- Specific design considerations, such as wildlife sensitive night-lighting, fencing, habitat protection and restoration, wildlife bridges and connectivity.
- Develop and implement capital funding programs to fund the adoption and incorporation of BSUD in Council projects in order to support a nature positive environment.

Project 3: A Climate Resilience Tree Framework

Knox City Council commissioned the Climate Resilient Tree Framework to provide baseline information on the climate resilience of Knox's current street tree network. The project developed a framework to support the decision making in the planning and management of a climate resilient streetscape that also supports a comprehensive habitat corridor network.

Climate change and urban heat are major challenges for the planning and management of urban forests, the biodiversity they support, and the ecosystem services they provide. Managers of street trees must understand the resilience of tree species in a changing climate and plan for streetscapes that are more resilient.

The framework highlights that a range of climate resilience actions are possible that are constrained by budgets and knowledge. These decisions are predominantly focussed on species selection. Different decisions may happen in different parts of the landscape (e.g., new climate adapted species may be introduced to ornamental landscapes, while the status quo or climate adapted provenances of existing species may be introduced in bushland reserves). Changes to species composition and abundance will affect the ecological and social functions and services, and in turn the benefits delivered by the urban forest. For example, replacing locally indigenous trees with unrelated species may lead to improved amenity (e.g., flowering and shade), but reduce habitat for local fauna and disrupt host-species interactions. Maintaining the status quo may lead to the decline of some species in future climates and the loss of the habitat and ecosystem services they provide.

The loss of local provenance species and genetic material may affect the cultural connections that traditional owners have with their country, or sense of place more broadly. Some of these effects are well understood but there are many knowledge gaps. These changes may also affect different parts of Knox's community (both human and non-human) in different ways.

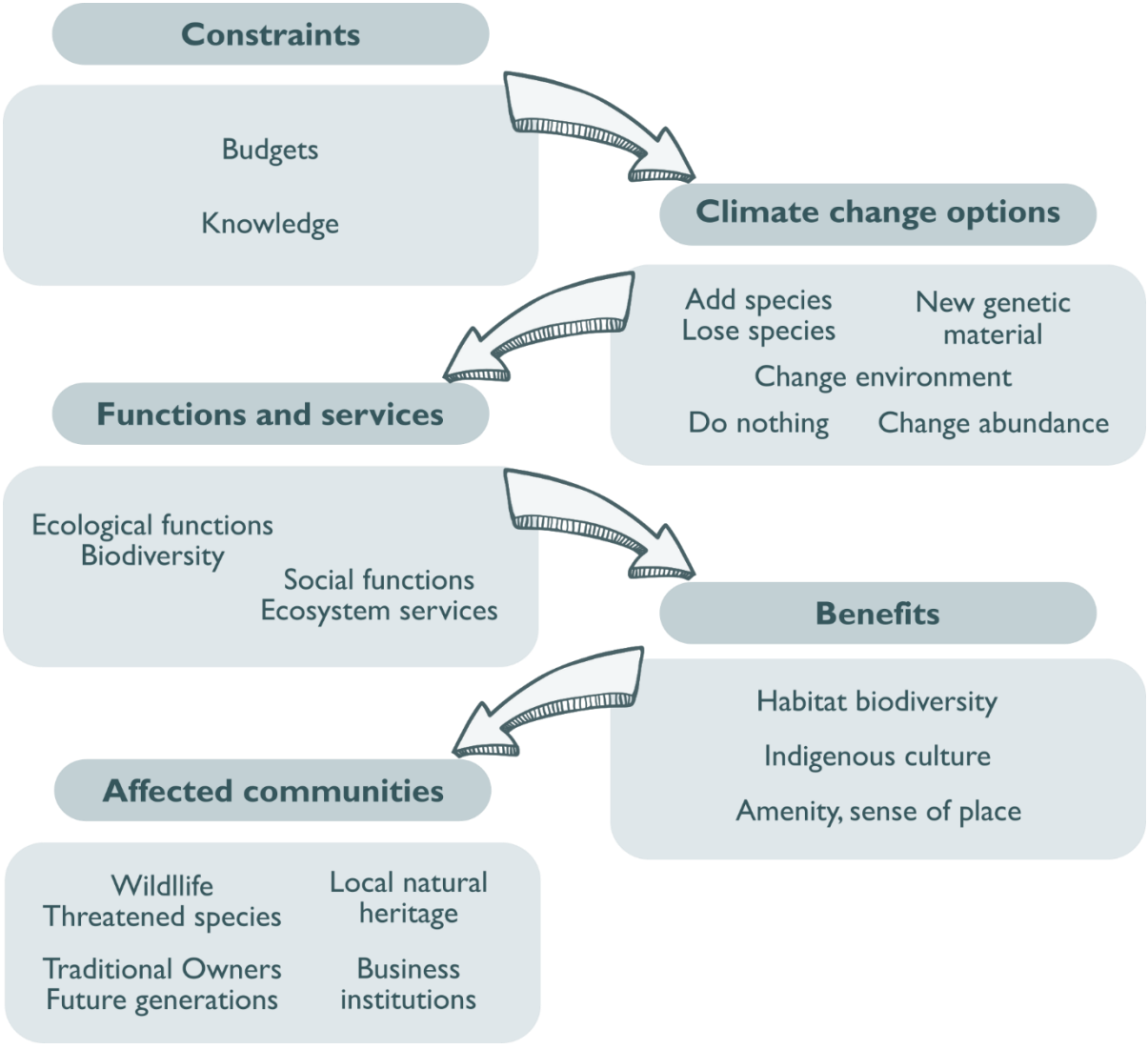


Figure 9. A climate resilient tree decision-making framework

As part of developing the framework, internal and external stakeholders from Council and key community members and groups (Knox Environment Society, Environmental volunteers) workshopped potential approaches to urban forest resilience. Three approaches were proposed to suit a range of scenarios appropriate to different locations, community values and ecological requirements (Figure 10).

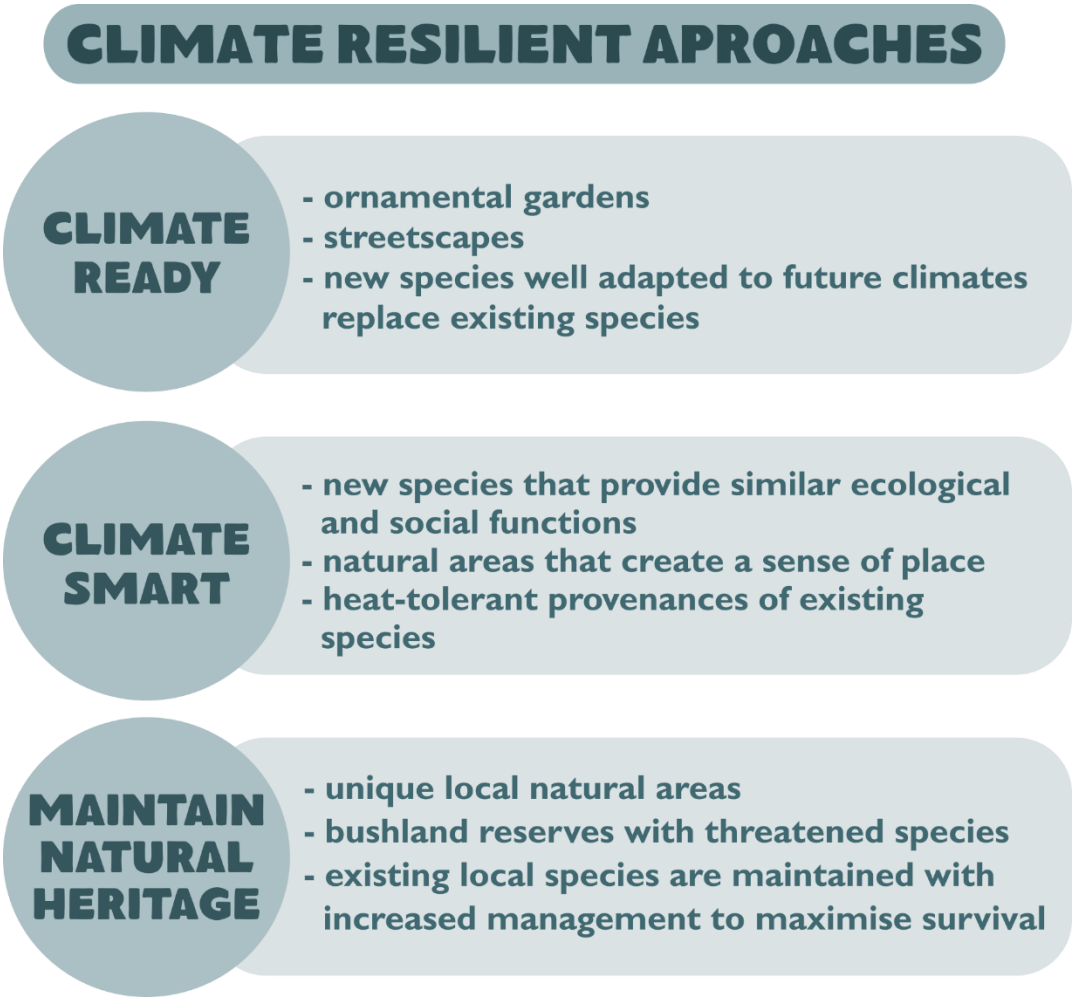


Figure 10. Various climate resilient approaches explored during workshop discussions.

These discussions highlighted the critical role that trees play in urban social-ecological systems, and how resilience is affected by ecosystem components (trees, shrubs, wildlife), indirect ecological factors (habitat corridors, temperature), and social and cultural functions (Indigenous connection to Country, mental health, amenity). Through these discussions, we identified areas that connect habitat are particularly valuable environmentally and culturally. For example, sites such as Dobsons Creek, Lewis Park, Blind Creek and Starlight Reserve hold significant Indigenous cultural values and contribute to the wellbeing of community aesthetically and recreationally.

Knox's current Street Tree selection (based on species in the street tree list) is quite well adapted to future climates, with only 5 of the top 50 species in the current tree inventory near the edge of their known climatic range even under the most extreme climate scenario – four deciduous northern European species (Betula pendula, Quercus palustris, Acer × freemanii, Tilia cordata), and one Tasmanian eucalypt (Eucalyptus pulchella).

An analysis of the whole street tree species list (Table 6 and Figure 5) shows that most trees and tree species are known to be at least as well suited to Knox's emissions limited temperature scenario than current conditions, perhaps because Knox draws on a pool of species cultivated across Melbourne, and much of Melbourne is warmer than Knox.

While the risk to the whole Knox municipality Street Tree matrix is relatively small, risk is not equitably distributed across the municipality. There are streets in Lysterfield in the south and to a lesser extent, Boronia in the north with uniform plantings of northern European and northern American species, which present a risk of not surviving in a warming climate.

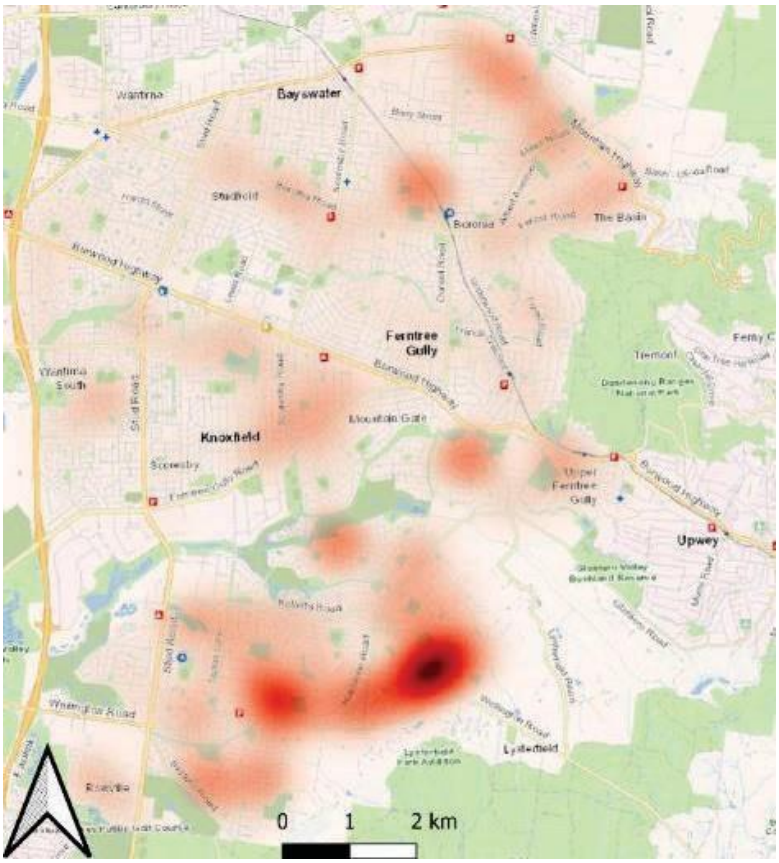


Figure 11. The spatial distribution of tree species risk across the municipality based on street trees that are at-risk in the business-as-usual climate scenario.

Key recommendations:

- Current research on climate suitability of trees being undertaken by Greening Australia and various universities should be incorporated into future revisions of this framework.
- The ecological implications of potential approaches to urban forest resilience should be considered within the context of Knox's ecological and socio-ecological systems.
- A comprehensive assessment of the ecological importance of new (those used to increase forest resilience), and existing species would aid urban forest decision making.

- Additional community engagement work, such as community surveys, would develop a broader understanding of the social implications, needs and preferences of the community regarding urban forest resilience approaches.
- The most important areas in Knox contributing to local natural heritage should be identified and actions to conserve local natural heritage should be prioritised in these landscapes.
- Knox's current Sites of Biological Significance data should be reviewed to ensure contemporary data is available to inform decision making.

MONITORING AND REVIEW

The biodiversity resilience of Knox will be reviewed every 10 years to determine the long-term objectives needed to ensure Knox's biodiversity remains healthy and resilient in the context of local threats and climate change. A core value of Council is that the actions and strategies taken towards biodiversity resilience be continuously improved via adaptive management approaches.

Indicators that will be used to measure improvements in biodiversity and the health of ecosystems are:

1. Implementation of policy and process that incorporates BSVD in capital and operational works.
2. Habitat connectivity. The ratio of linked to unlinked areas of habitat. Habitat connectivity actions and projects (revegetation) are prioritised in high-priority areas as outlined in Project 2 of this Strategy.
3. Species diversity and health. Increase in the diversity and health of Indigenous species represented within Knox. A reduction in the risk of further species extinction within Knox from an improvement of species and ecosystem health. Consider the findings of past and future Sites of Biological Significance reports.
4. The status of EVCs within Knox and the health of ecosystem functions. Determine if the conservation status of EVCs within Knox has changed or is likely to change. Consider the findings of past and future Sites of Biological Significance reports.
5. Tree canopy cover. Increase tree canopy cover with the goal of achieving the 30% of land cover by 2050.
6. Community participation in biodiversity education programs (e.g. Gardens for Wildlife, Biodiversity Buddies Grant Applications, Nature Stewards) and stewardship activities (e.g., Friends groups, citizen science).
7. Activity with regional partners. Determine if regional programs and partnerships have had positive outcomes for biodiversity resilience in Knox.

Project 4: High Level – Biodiversity Flagship Action Themes

BIODIVERSITY VISION

The native flora, fauna and ecosystems of Knox create a thriving and resilient natural environment in which the community coexists in working towards a nature positive future.

CONNECT

1.1 Educate, upskill and empower community

1.2 Support and protect our native wildlife

1.3 Cross organisation collaboration to support the delivery of 30% tree canopy coverage

OPERATIONAL ACTIONS

PROTECT

2.1 Support, protect and enhance our biodiversity in Knox

2.2 Enhance livability

2.3 Identify habitat links and develop action plans

OPERATIONAL ACTIONS

ADAPT & INNOVATE

3.1 Pilot and implement best practice projects and actions

3.2 Exploring opportunities to implement biodiversity sensitive urban design in capital projects

3.3 Develop an understanding of community values towards the environment, biodiversity and trees

OPERATIONAL ACTIONS

Key Measures of Success

The Key measures of success (below) have been identified as some of the fundamental actions (outlined in the Biodiversity Operational Action Plan) to ensure a successful delivery of the Strategy.

- Development of up to 7 habitat corridor plans over the duration of the strategy.
- Develop a community engagement process to inform the development of the corridor action plans.
- Develop a policy and process for an Urban Biodiversity Sensitive Urban Design guide for infrastructure projects.
- Recruitment of Environmental Weed Officer (0.6 EFT)
- Develop an Environmental Weed Strategy
- Develop a program of environmental weed education and campaigns
- Incorporation of key bushland sites into the corridor mapping which include 'secondary' linkages and stepping stones that connect ecological priority areas.
- Development of fact sheets - focal species and stories
- Undertake mapping and analysis of tree canopy to develop incremental tree canopy target milestones and actions.

E.g. 2030/35, 2040/45, 2050

GLOSSARY OF TERMS

Biodiversity – The variety of life on Earth. There are three levels of biodiversity, including genetic, species and ecosystem diversity.

Ecosystem – All living things in a given area, interacting with each other and with the abiotic factors in their environment.

Endemic – Native plant or animal restricted to a certain place.

Indigenous species – A plant species that naturally occurs in an area and was present prior to 1788.

Resilience - The capacity of a substance or object to recover from disturbance and return to the pre-disturbance state or condition.

Ecosystem services – The benefits provided to people by ecosystems, including provisioning (e.g., food and fibre), regulating (e.g., cooling), supporting (e.g., soil formation) and cultural (e.g., recreation, heritage) services.

Urban forest – The tree-based vegetation communities that occur in cities, including all land uses and both public and private land.

Urbanisation – The process of making an area more urban, typically with higher density of human residents, buildings, roads and reduced canopy cover, open space, and biodiversity.

DEECA – Department of Energy, Environment & Climate Action

Locally Extinct – Termination of a species in a specific geographical area (in this case Knox), though it still exists elsewhere

Regeneration – a region defined by characteristics of the natural environment rather than by man-made divisions

LGA – Local Government Area

EVC – Ecological Vegetation Class.

APPENDIX

1. List of 27 emblematic species

Species	*Conservation Status*	*Species in Knox Atlas (1998-2017)*	*Knox Atlas # of records*	*VBA & ALA record numbers*	*Species/group mentioned in community online surveys*
Southern Toadlet *Pseudophryne semimarmorata*	en	Yes	20	105	Yes (generally referred to as frogs in surveys)
Blue-billed Duck *Oxyura australis*	vu	Yes	142	157	Yes
Powerful Owl *Ninox strenua*	vu	Yes	68	1286	Yes
White-plumed Honeyeater *Ptilotula penicillata*		Yes	1039	1537	Yes
Short-beaked Echidna *Tachyglossus aculeatus*		Yes	41	26	Yes
Australian King-Parrot *Alisterus scapularis*		Yes	250	2159	Yes
Eastern Great Egret *Adrea alba modesta*	vu	Yes	441	663	Yes (generally referred to as Egret in surveys)

Species	*Conservation Status*	*Species in Knox Atlas (1998-2017)*	*Knox Atlas # of records*	*VBA & ALA record numbers*	*Species/group mentioned in community online surveys*
Eastern Yellow Robin *Eopsaltria australis*		Yes	820	1162	No
Crimson Rosella *Platycercus elegans*		Yes	1178	2287	Yes
Gang-gang Cockatoo *Callocephalon fimbriatum*		Yes	105	157	Yes
Rainbow Lorikeet *Trichoglossus molucannus*		Yes	2329	1549	Yes
Sacred Kingfisher *Todiramphus sanctus*		Yes	157	951	No
Tawny Frogmouth *Podargus strigoides*		Yes	200	1058	Yes
Yellow-tailed Black Cockatoo *Calyptorhynchus funereus*		Yes	289	1887	Yes
Southern Shortfin Eel *Anguilla australis*		No	0	47	Yes (generally referred to as eels in surveys)
Australian Admiral Butterfly *Vanessa itea*		Yes	16	10	Yes (generally referred to as butterflies in surveys)

Species	*Conservation Status*	*Species in Knox Atlas (1998-2017)*	*Knox Atlas # of records*	*VBA & ALA record numbers*	*Species/group mentioned in community online surveys*
Blue Skinner Dragonfly *Orthetrum caledonicum*		No			Yes (generally referred to as dragonflies in surveys)
Sugar Glider *Petaurus breviceps*		Yes			Yes
Dandenong Burrowing Crayfish *Engaeus urostrictus*	cr	No	0	2	Yes (generally referred to as Burrowing Crayfish in surveys)
Tubercle Burrowing Crayfish *Engaeus tuberculatus*	en	No	0	2	Yes (generally referred to as Burrowing Crayfish in surveys)
Superb Fairywren *Malurus cyaneus*		No	0	13694	Yes
Common Galaxias *Galaxias maculatus*		Yes	22	2	-
Dwarf Galaxias *Galaxiella pusilla*		Yes	20	0	-
Agile Antechinus *Antechinus agilis*		Yes	13	9	-
Blotched Blue-tongues Lizard *Tiliqua nigrolutea*		Yes	12	4	Yes (generally referred to as blue-tongues in surveys)

Species	*Conservation Status*	*Species in Knox Atlas (1998-2017)*	*Knox Atlas #*	*VBA & ALA numbers*	*Species/group mentioned surveys*
Eastern Snake-necked Turtle *Chelodina longicollis*		No	0		Yes (generally referred to as turtles in surveys)
Garden skink *Lampropholis guichenoti*		Yes	30		Yes (generally referred to as skinks in surveys)

II. List of notable weeds in Knox and their scientific names

Notable weeds (common names)	*Scientific names*
Sweet pittosporum	*Pittosporum undulatum*
Blackberry	*Rubus fruticosus* agg.
Cotoneaster	*Cotoneaster* spp.
Angled Onion	*Allium triquetrum*
Sweet vernal grass	*Anthoxanthum odoratum*
Asparagus fern	*Asparagus aethiopicus, A. africanus, A. plumosus, A. delinatus, A. scandens*
Large quaking grass	*Briza maxima*

Notable weeds (common names)	*Scientific names*
Greater bindweed	*Calystegia sepium*
Red cestrum	*Cestrum elegans*
Boneseed	*Chrysanthemoides monilifera*
Hawthorn	*Crataegus monogyna*
Montbretia	*Crocosmia x crocosmiiflora*
English broom	*Cytisus scoparius*
English Ivy	*Hedera helix*
Cape Ivy	*Delairea odorata*
Sallow wattle	*Acacia longifolia*