



JERRABOMBERRA CREEK CATCHMENT PLAN

Community Caring for Catchment

11 June 2021

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Report prepared by GrassRoots Environmental on behalf of the ACT Parks and Conservation Service Offsets Team in partnership with the Australian River Restoration Centre.

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Acknowledgement of Country

We respectfully acknowledge the Traditional Owners of the land, the Ngunnawal people, and pay our respects to Elders past and present, and to our future emerging leaders. We would also like to extend our respect to other Aboriginal and Torres Strait Islander people in our community. We are proud to work in partnership with our Traditional Owners to improve the health of our rivers and catchments.

Executive Summary

‘Looking after Country involves maintaining a balanced physical, social and spiritual environment and contributing to the continuity and renewal of complex relationships between people and the environment’ (State of the Environment Report ACT 2019)

The Jerrabomberra Catchment Plan came about in response to the ACT Parks and Conservation Service Offsets team desire to improve the Jerrabomberra creek in the Jerrabomberra Grasslands, while protecting and enhancing habitat for the critically endangered Grassland Earless Dragon and other threatened species. Managing Grassland Earless Dragons at the site or local landscape scale is appropriate, however, it is important for the management of the Jerrabomberra Creek to be at the catchment scale for effective water quality and biodiversity outcomes.

The ACT Government had the foresight to recognise this and extended the Plan to cover the entire Jerrabomberra catchment. This ‘whole of catchment planning’ approach enables management of the grasslands and endangered species, as well as allowing for the inclusion of the many other threatened communities and species that inhabit the Jerrabomberra Creek Catchment. It also enables multiple scales to be considered and, most importantly, prioritises landscape and ecosystem connectivity.

The development of a comprehensive catchment plan also provides the opportunity for strong community engagement and focussed, unified action. There is a large diversity of stakeholders, including Traditional Custodians, private landholders, ACT and NSW Governments, community groups, researchers, non-government organisations and industry. The Plan gives all stakeholders the opportunity to work together to protect and improve the Jerrabomberra Creek Catchment and its values. The Plan recognises that people are interconnected with the environment in which they live and manage, and that the choices they make can make a tangible difference.

PCS Offsets engaged GrassRoots Environmental, geoAdapt and the Australian River Restoration Centre to develop the Plan in partnership with the Molonglo Conservation Group. The Plan will enable stakeholders to come together to help implement the Plan over the next five years. Although the actions in this Plan map out a practical path forward, the intent is that the Plan will continue to evolve over time, as monitoring and evaluation informs progress and ongoing actions.

The Jerrabomberra Creek Catchment Plan is divided into the following sections:

- The Back Story (Section 1)
- Looking After our Waterways and Riparian Lands management (Section 2)
- The story of the Jerrabomberra Creek Catchment (Section 3)
- Community Groups (Section 4)
- Legislation and Planning (Section 5)
- Management Principles and Actions (Section 6)
- Implementation Plan (Section 7)

The Implementation Plan (Section 7) is further broken down into nine sections of creek as follows:

- Section 1 Headwaters
- Section 2 Headwaters to Pingarra
- Section 3 Pingarra to Old Cooma Road
- Section 4 Old Cooma Road to Church Creek
- Section 5 Church Creek to Fernleigh Park
- Section 6 Fernleigh Park to Jerrabomberra
- Section 7 Jerrabomberra to the ACT Border
- Section 8 ACT Border to Narrabundah
- Section 9 Narrabundah to (and including) Jerrabomberra Wetlands

For each section the following themes are covered:

- Description
- Important Natural Assets
- Threats
- Past and Current Initiatives
- Recommended Actions
- Project Focus Areas
- Next Steps
- Key Contacts

The intention of this Plan is that it be made available online where each landscape section is presented individually, for stakeholders to download and use for their planning and implementation purposes. This also enables the Plan to be regularly updated, as more initiatives are undertaken, and more knowledge is gained. This will make it a truly community-owned Plan and input from community is welcomed and encouraged, as it will enable the content to be developed into actions.

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1 The Back Story

1.1 How did the Jerrabomberra Creek Catchment Plan come about?

The development of the Jerrabomberra Creek Catchment Plan (the Plan) began with a general discussion with staff from ACT Parks and Conservation Service (PCS) about the management of Jerrabomberra Creek where it runs through the Jerrabomberra East Grasslands Reserve in the Australian Capital Territory (ACT). The PCS Offsets team were investigating options to improve the creek, while protecting and enhancing habitat for the Grassland Earless Dragon (a critically endangered species) and other threatened species in the vicinity. Managing Grassland Earless Dragons at the site or local landscape scale is appropriate, however, management of the Jerrabomberra Creek needs to be at the catchment scale for effective water quality and biodiversity outcomes to be achieved. The ACT Government had the foresight to recognise this and extended the Plan to cover the entire Jerrabomberra catchment. This 'whole of catchment planning' approach enables management of the grasslands and endangered species, as well as allowing for the inclusion of the many other threatened communities and species that inhabit the Jerrabomberra Creek Catchment. It also enables multiple scales to be considered and, most importantly, prioritises landscape and ecosystem connectivity.

The development of a comprehensive catchment plan also provides the opportunity for strong community engagement and focussed, unified action. There is a large diversity of stakeholders, including Traditional Custodians, private landholders, ACT and NSW Governments, community groups, researchers, non-government organisations and industry. The Plan gives all stakeholders the opportunity to work together to protect and improve the Jerrabomberra Creek Catchment and its values. The Plan recognises that people are interconnected with the environment in which they live and manage, and that the choices they make can make a tangible difference.

PCS Offsets have engaged GrassRoots Environmental and the Australian River Restoration Centre to develop the Plan. In partnership with the Molonglo Conservation Group, stakeholders will be brought together to help implement the Plan over the next five years. Although the actions in this Plan map out a practical path forward, the intent is that the Plan will continue to evolve over time, as monitoring and evaluation informs progress and ongoing actions. **This version of the Plan is a "first cut", and input from community is welcomed and encouraged, as it will enable the content to be developed into actions.** The intention of this Plan is that it be made available online and presented in landscape sections that different stakeholders can download and use for their planning and implementation purposes. This enables the Plan to be regularly updated, as more initiatives are undertaken, and more knowledge is gained. This will make it a truly community-owned Plan.

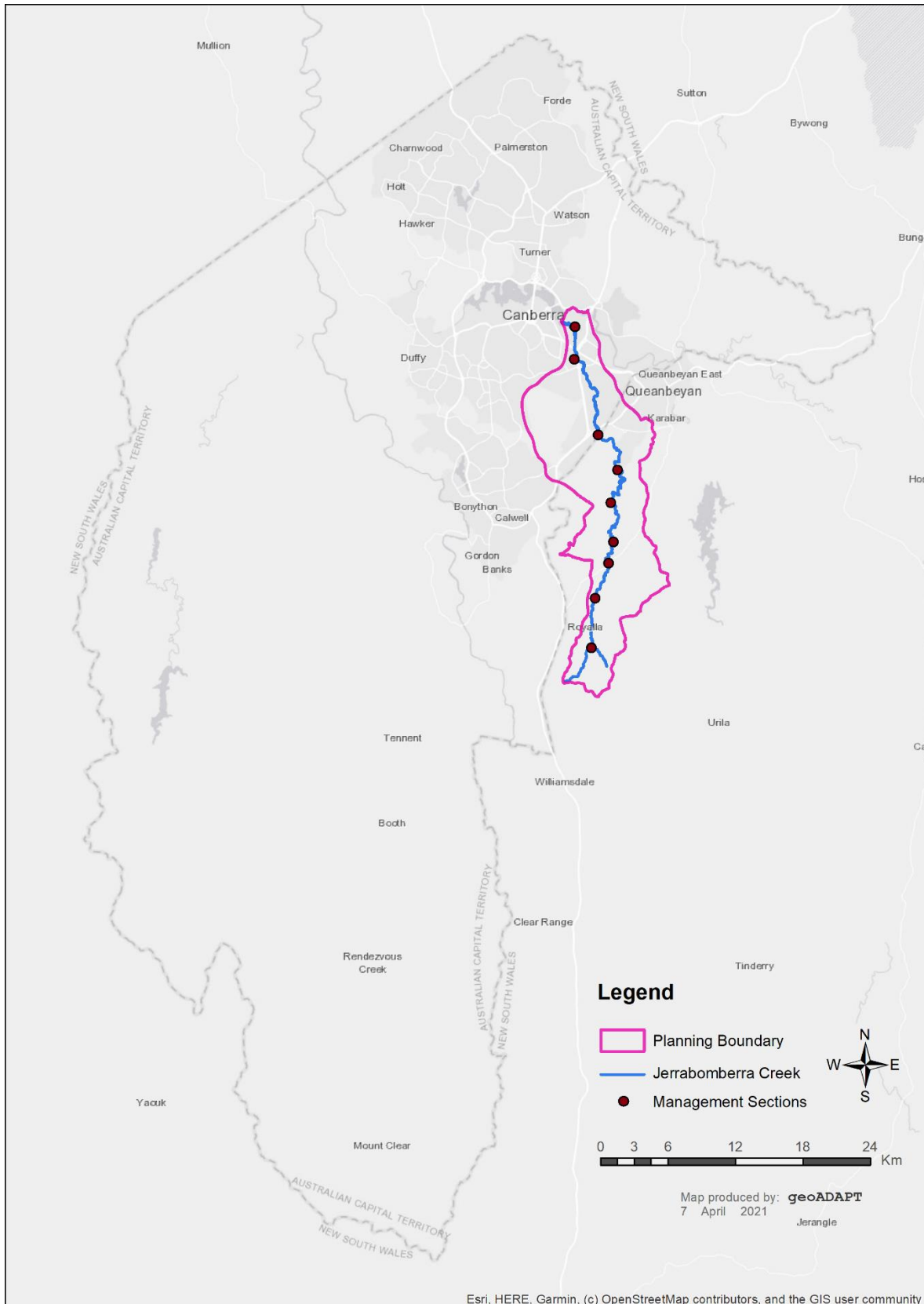
1.2 Why is Jerrabomberra Creek so important?

The Jerrabomberra Creek is a major tributary to Lake Burley Griffin, winding its way from headwaters in Royalla, and travelling through many different landscapes and tenures (both public and private). It provides water, wildlife habitat, livestock shelter and amenity, as well as being home to a number of threatened species and communities. Map 1 shows the location of the Jerrabomberra Creek Catchment. Some notable conservation values include:

- Natural Temperate Grassland Reserves including populations of the critically endangered Grassland Earless Dragon.
- Wandiyali Sanctuary which protects Endangered Ecological Box Gum Woodland Community and many threatened and declining plants and animals.
- Jerrabomberra Wetlands - a nationally important reserve in Australia and home to over 300 species of birds including a number of listed migratory species.

Jerrabomberra Creek Catchment is also a breeding ground for a diverse range of birds, including declining woodland and wader birds, tortoises, frogs, platypuses, bats, Rakali and other mammals. It is also home to a diversity of aquatic macroinvertebrates, critical for ecosystem health and good water quality. In addition to environmental values, the catchment provides socio-cultural and business opportunities, rural lifestyles, agriculture, industry, urban amenity and well-being, along with flood mitigation and filtration of stormwater pollutants.

Currently, activities along the creek and management of the catchment are disjointed, with many different tenures and overarching governance. There is great potential however, for the Jerrabomberra Creek Catchment to be a showcase of restorative landscape and catchment management activities. As mentioned above, the catchment contains unique and important values and has an active stakeholder base – this means it presents the opportunity to create a model of outstanding catchment management, providing outcomes with multiple benefits.



Map 1 Location of Jerrabomberra Creek Catchment

1.3 What is the purpose of the Catchment Plan?

The aim of the Jerrabomberra Creek Catchment Plan is to map out practical and clear actions that stakeholders can implement together in order to improve water quality, ensure habitat availability and connectivity for significant species (such as the Grassland Earless Dragon), enhance biodiversity, and improve sustainable living and production.

The Jerrabomberra Creek Catchment Plan prioritises work across both NSW and the ACT, with reference to the overarching legislative framework and governance, community engagement opportunities and capacities, and feasibility. Recommendations are based on a large volume of supporting information, as well as a sound and detailed understanding of the catchment and the community.

1.4 Who developed the Catchment Plan and who helped?

The Jerrabomberra Creek Catchment Plan has been prepared by GrassRoots Environmental in partnership with the Australian River Restoration Centre, and with funding from PCS Offsets, who are behind this initiative. The Plan draws on many sources of knowledge, with the Molonglo Conservation Group, a key player and author of the Molonglo Catchment Strategy (which includes Jerrabomberra Creek Catchment). The group, spanning both the ACT and NSW, and connected with multiple stakeholders, will remain an important part of the implementation of this plan as it evolves. PCS, specific groups and key individuals were also consulted about the Plan to fill information gaps or to seek clarification, however the finalised plan will provide the main opportunity for input by the broader community which is very welcome.

1.5 Who is the Catchment Plan for?

The Jerrabomberra Creek Catchment Plan is for anyone living, working and managing land and water within the Jerrabomberra Creek Catchment. The Plan is an example of practical catchment management that is led by government and community in partnership. The Plan begins with an overview of why we should look after our waterways, it then focusses on the values of the Jerrabomberra Creek Catchment and outlines some of the areas that need to be addressed in relation to working within a multi-tiered governance and legislative landscape. It then drills down into management priorities and specific actions for individual sections of Jerrabomberra Creek.

1.6 Are there any Limitations?

Although this Plan draws together available information to feed into management recommendations, there are some areas where there are significant information gaps. As the Plan evolves many of these knowledge gaps will be addressed. As a working document the Plan will need to be updated periodically as new information comes to light or as actions are implemented. As mentioned above, any feedback or comments on the draft will be gratefully accepted.

1.7 Acknowledgements

- *Maree Gilbert*, manager of the ACT Parks and Conservation Service Offsets South team who had the insight and vision to support the development of a holistic plan for the whole of the Jerrabomberra Creek Catchment recognising the importance of managing waterways at the catchment scale for the best outcomes at the reach-scale,
- *Dr Siwan Lovett*, Director of the ARRC, for her support, guidance and considerable editing efforts,
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- *Karen Williams*, Molonglo Conservation Group, for her advice and input,
- *Carolyn Larcombe*, Wandiyali Conservation Trust for hosting a PCS site visit to look at reference condition ecosystems.
- *Maryke Booth*, Royalla Landcare, for her advice and enthusiasm.
- There are also many other people who have contributed to projects and planning in the Jerrabomberra Creek catchment over several decades whose information and experience has been invaluable including Landcare Groups, Greening Australia, landholders, Traditional owners, DPIE (formerly OEH), South East Local Land Services, Small Farms Network, Waterwatch, Frogwatch, researchers and the broader community.

2. Looking After our Waterways and Catchments

‘For many of us, water simply flows from the tap, and we think little about it beyond this point of contact. We have lost a sense of respect for the wild river, for the complex workings of a wetland, for the intricate web of life that water supports. We need to re-acquaint ourselves with our connection to nature... connection is health’ – Sandra Postel (Director and founder of the Global Water Policy Project).

This chapter provides an overview of the main principles for sound management of waterways and catchments. In addition to this overview, the Australian River Restoration Centre has a series of resource packs available where more information can be accessed free of charge at <https://arrc.com.au/resource-centre/>.

2.1 Healthy Land and Water

Human wellbeing, as well as terrestrial and aquatic ecosystems, is dependent on healthy land. The interactions of soil, air, water, plants, animals and natural processes, provide a diverse range of services to human wellbeing, including fertile soil for agriculture, clean water production, nutrient recycling, and erosion control. How land is used and managed can significantly affect its capacity to provide these services (ACT Commissioner for the Environment 2019).

Unsustainable land use can lead to the loss of vegetation and habitat, and severely impact water quality and aquatic biodiversity. This in turn also impacts agricultural production, through the loss of soil nutrients and organic matter, reductions in crop yields and pasture production, and increased erosion. Healthy land supports agriculture, native ecosystems and their services, such as clean water. Soil is the main driver of land health through biological activity, specifically the cycling and storage of nutrients and carbon, and the decomposition of organic waste. The removal of vegetation through clearing, fire, grazing or cropping (particularly groundcover) can result in accelerated erosion, acidification, salinity, and a reduction in soil nutrients and organic content. In addition, soil erosion can increase due to the compaction of soil from urban and industrial activities, vehicle use, livestock grazing, and invasive species such as horses, deer and feral pigs (ACT Commissioner for the Environment 2019). Climate change will add to the pressures on the health of landscapes due to higher temperatures, reduced rainfall, more extreme weather events, and an increase in fire risk and severity. Underpinning all this is the loss of traditional cultural land management practices that Indigenous peoples used to look after the land for tens of thousands of years.

These pressures have a direct and significant effect on our waterways and water quality. Our waterways not only provide our water, but managed properly, are a haven for biodiverse wildlife. They are also responsible for the ecological processes that keep our water and air clean. Protecting and restoring our waterways is essential so that they can continue to provide a multitude of benefits, including:

- Protecting water quality through a mixture of biological, chemical and physical processes. For example, in-stream vegetation traps sediment, reducing turbidity and locking up nutrients to control algal blooms; bacteria convert ammonia to nitrate (waste to plant food); and macroinvertebrates shred up coarse particulate matter for filter feeders to clean. All the different components of these ecosystem processes work together to clean our water.
- Native vegetation (ground cover, mid and overstorey) promotes the infiltration of water into soil, reduces run-off, provides habitat and food for native wildlife, and food and shelter for domestic livestock. While exotic species also do this to some degree, the diversity of species is usually low in comparison with native vegetation, and native wildlife is not as well adapted to exotic vegetation. Native vegetation also provides habitat for crop pollinators and small birds which help control insect pests.
- Living and non-living landscape elements provide habitat for many lifeforms, from the smallest microscopic organisms, right through to the largest of mammals and reptiles. This is important as diversity is key to ecosystem function and interactions.
- Sequestering carbon via plants and soil which is part of the solution to abating climate change.
- Promoting and supporting human health and well-being, which is dependent on the health of our environment, not only for provision of the services mentioned above, but for aesthetics, recreation and enjoyment.

2.2 Riparian Lands

Riparian land deserves a special mention, because it is often the most fertile and productive part of the landscape, in terms of both agricultural production and natural ecosystems. The term riparian is used by practitioners is defined as *'any land which adjoins, directly influences, or is influenced by a body of water* (Lovett and Price 2002). The body of water could be a creek or stream (even if it flows only occasionally), a river, a lake, or a wetland'. It often has deeper and better-quality soils and supports a higher diversity of plants and animals than the surrounding hillslopes. Many native plants are found only, or primarily, in riparian areas, and these areas are also essential to many specifically adapted animals such as macroinvertebrates (water bugs), which are aquatic for all or part of their lifecycle.

The vegetation on riparian land regulates in-stream primary production through shading; supplies energy and nutrients; and provides essential aquatic habitat by way of large pieces of wood that fall into the stream and through root-protection of undercut banks. It also sequesters more carbon than that of the surrounding landscape with most of the river systems in Australia now containing less than 2% of the carbon they once sequestered (Wohl 2016). It is for these reasons that riparian lands are targeted for protection and rehabilitation.

In addition to being productive, riparian land is often a vulnerable part of the landscape due to risk of damage from cultivation or over-grazing and natural events such as floods. The combination of productivity and vulnerability means that careful management of riparian land is vital for conservation of Australia's unique biodiversity, for continued agricultural productivity and for recreational, aesthetic and spiritual values.

Sound riparian management is not a substitute for good land management elsewhere in the catchment. Rather, it should be seen as one part, albeit a very important part, of sound management throughout the property or catchment. Even the best management of riparian lands will not overcome poor management practises elsewhere that lead to excessive soil erosion, or off-site loss of nutrients or other contaminants. Planning is, therefore, the key to successful management of riparian land.

Some of the common issues that plague our waterways include erosion of stream banks, the formation of gullies, loss of riparian vegetation, loss of habitat and connectivity for fish and other wildlife, feral fish species, and a dominance of exotic plant species such as willows and woody weeds that reduce native diversity and cause disruption in food webs. In most waterways there are a combination of threats at play, and the overall recovery potential of a waterway will depend on how far the system has been tipped out of balance. On the positive side however, these systems tend to have a quick response once restorative action is taken and, although some waterways will never fully return to what they once were, they can function well enough to provide multi-benefits such as clean water, shelter, habitat and aesthetics. Rivers are supposed to be messy and complex for optimum ecological function – not neat, tidy and simple as people are often accustomed to aesthetically.



Photos 1 (left) and 2 (right). Photo 1 shows a relatively simple and tidy river and Photo 2 shows a complex messy river which is ecologically healthier.

Some of the issues specific to the Jerrabomberra Creek Catchment are unpacked below in more detail. These are derived from on-ground assessment, literature review and a community survey undertaken as part of the development of the Molonglo Catchment Strategy. The main issues include willow invasion (2.2.1), erosion and soil loss (2.2.2) and loss of riparian vegetation connectivity (2.2.3).

2.2.1 Willow Management

Willow management, which can be an emotive topic, is mentioned specifically because willows occur throughout the Jerrabomberra Catchment. Viewpoints often differ on whether willows are friend or foe. While there are people who promote the use of willows for improving rivers and creeks in Australia, there is a large body of evidence that cautions against this. One or two willows may look nice along a waterway, but many species spread very quickly to dominate entire stretches, at which stage they are costly and difficult to control. It is also difficult to establish other vegetation amongst them, impeding attempts to improve biodiversity. There is good reason why all willows are identified as Weeds of National Significance. This identification is due to their impacts on waterways all around Australia; observed, monitored and evaluated by many different researchers, community groups and individuals over several decades from a time when willows were deliberately planted for stream bank erosion control.

While the aesthetic quality of willows, their use as livestock feed and their ability to colonise along waterways is not disputed, the destructive nature of most willow species as a threat to the health of Australian waterways is well documented. Key problems are outlined below:

- Once colonised along a riverbank, there are few demonstrated cases (if any) where willows have enabled the establishment of native vegetation.
- Willows do not provide suitable habitat for native animals or birds that rely on tree hollows, and although they provide shade for fish in the absence of other vegetation, they do not promote the diversity of macroinvertebrates that fish rely on for food. These changes to the in-stream invertebrate populations result in a reduced species richness overall and simplify food webs.
- Some willow species can produce massive amounts of wind-dispersed seed that results in large seedling germination events on banks and island bars. This impacts on water flow as well as reducing vegetation diversity.
- Willows produce stem pieces that spread invade entire channels and their banks.
- Willows lose their leaves in Autumn with this large amount of leaf litter clogging up streams and reducing oxygen in the water. This can then create anoxic conditions for fish and the inability for existing processes to use up the excess nutrients.
- Willow wood breaks down very quickly in-stream and does not provide the same level of habitat for native fish and other wildlife.
- The seasonally dense shade willows produce does not allow other species to establish underneath, in particular native shrubs which many macroinvertebrate and fish species rely on as habitat for their food sources.
- Although willows are often planted in attempts to stabilise stream banks once the tree has grown, it deflects water back into the bank causing erosion. It is common to see banks carved out behind a bank of willows.

Once a willow infestation has established and action is needed to remove it, there are number of constraints that need to be addressed:

- Increase in erosion through lack of stabilisation if large infestations are removed at once.
- Increase in flow velocities, potential for more erosion, higher flood peaks over a shorter duration.
- Potential for them to be replaced by other weedy species, often Blackberry, Gorse and other woody weeds.
- Potential for infrastructure like bridges to be damaged if large amounts of material break down at once.

While it is only a possibility that one or more of the above problems will occur, the potential for negative consequences needs to be considered as part of any large willow control program, with appropriate actions taken to minimise potential issues.

It helps to understand how willows spread to enable an informed decision to be made about prioritising control (Bear 2007). It is important to prioritise highly invasive species that spread vegetatively and form dense infestations (like Crack Willow) If they are already a dense infestation, it may be appropriate to manage their

downstream spread instead. In contrast, small numbers of Weeping Willows spaced apart along a waterway are not usually an issue. In some cases, removal of willows may need to be deferred until other issues are addressed. In heritage sites, for example, one sex may be removed to remove the risk of seeding, this is a strategy that has been used in some areas around Lake Burley Griffin (Gould 2006). An assessment also needs to be made about the impact of the willows on biodiversity at any given site, and sites with high biodiversity (particularly upstream) need to be of higher priority.

Willow control methods need to be appropriate to the density of the infestation and size of individual plants. Glyphosate is the only chemical registered for use around waterways and is very effective. This can be applied as an overspray for small shrubby plants, painted onto a cut stem (cut and paint), or injected into the main trunk or into multiple stems in the case of multi-stemmed willows (stem injection). It is important this is done properly by trained operators, to ensure a good kill; willows not killed on the first attempt often become resistant and difficult to eradicate. Prior to willows being killed, a decision needs to be made on whether it is appropriate to leave the debris in-situ or remove it altogether (e.g. if there is a risk of damage downstream).

Another control method is removal of trees (dead or alive) by a purpose-built excavator which has a log grab, saw, sprayer and rake incorporated into the arm. If the willows have not been previously killed, a follow up spray program is required for several years to kill the bits that break off and grow; if untreated willows are left upstream this may be an ongoing concern (Gould *pers. Obs.* 2014). There have been a number of willow control programs which have not been followed up appropriately and now pose the same threats that the original infestation posed. Replacement of willows with native vegetation is extremely important. If there is already suitable native plant species then planting may not be necessary, however, this is seldom the case large willow infestations.

When considering a willow control program, steps should be taken to identify the impacts, assess the rate of spread, identify the species, look at sources of ongoing infestation, ascertain possible impacts on the waterway if they are removed, determine appropriate control techniques, undertake debris management and any follow up requirements. There are also a number of willow control projects that have not been well planned and / or executed which have had erosion associated with removal, damage to infrastructure downstream and impacts on water temperature and evaporation. Rather than being a reason not to control willows, it illustrates why good planning is of critical importance.

2.2.2 Erosion

Streams meander through the landscape, and the straight lines and channels favoured by humans are not 'natural'. Stream bank erosion is a dynamic and natural process as rivers meander across their floodplains. Human influence, through catchment development, stream regulation, removal of large wood, and clearing or non-regeneration of riparian vegetation, can greatly increase the rate of bank erosion, sometimes to unacceptable levels.

There are three main processes that cause bank erosion (LWRRDC 1998), and it is essential to determine which are operating at a site, because the management required to slow or prevent them may differ. The relative importance of the three erosion processes often varies with position in the catchment.

- 1) *Sub-aerial erosion* involves processes that loosen the bank soil which can then be washed away by the water flowing past (especially where water level rises and falls frequently). Raindrop impact, desiccation, frost freeze-and-thaw, and trampling by animals are significant loosening processes. This form of erosion is reduced by maintaining full vegetative cover of the bank using low-growing riparian species that can lay down during peak flows so that they are not lost during floods.
- 2) *Mass failure or slumping* occurs when blocks of the bank collapse as a result of undercutting or other type of structural weakness, such as the development of tension cracks when soils dry rapidly or water level drops suddenly after a flood. Deep-rooted trees and shrubs along the top and slope of the bank can reduce slumping as their roots reinforce the bank soil across potential failure planes; and their uptake of water reduces soil weight and increases cohesiveness.
- 3) *Fluvial Scour* occurs when the force applied to the bank soil by the water and suspended particles flowing past exceeds the resistance of the surface. The toe of the bank at the water's edge is a crucial place for scour as continued erosion here leads to undercutting of the bank and its eventual collapse. Scour is also common

at the outer band of a stream, where the water velocity is higher. Scour can be reduced by maintaining good vegetative cover of the bank, which reduces flow speed and provides physical protection from the flow and entrained particles; plant roots on the bank surface can also provide physical protection. In a high-erosion situation, the toe may need special protection using secured plants, wood or rock.

Rapid bank erosion leads to loss of valuable land, reduced water quality as sediment and nutrients enters the stream, and can threaten infrastructure such as roads, bridges and buildings. Stream bank erosion is the dominant source of sediment in many river systems, and sediment loads in Australian streams have generally increased by ten to fifteen times in comparison with pre-European loads in intensively used river basins (LWRRDC 2002). Gully erosion is generally caused by sub aerial erosion, but the processes that loosen the soil may be underground water seepage, whereby the soil is loosened and washed away by surface flow.

Vegetation is the most effective way of controlling and managing erosion and soil loss and is generally preferred as a first step prior to engineered structural works (due to cost and potential disturbance). Engineered structural works include dams, diversion banks, concrete and rock flumes and other structures that aim to create an environment that reduces the impacts of water flow on soil. Ideally any works should also enable the establishment of vegetation, in particular, deep rooted groundcover. It should be noted that structural works are only recommended where erosion activity is moving quickly and/or in a situation where vegetation cannot naturally establish without intervention.

When considering the use of revegetation at a catchment scale to reduce stream bank erosion and sediment loads, it is important to assess the following (Rutherford 2002):

- *Process* – Managers will be most effective in targeting riparian revegetation if they first understand the erosion mechanisms that are acting in a particular stream or river reach.
- *Leverage* – Once we understand the erosion mechanism, then we can understand the influence (the leverage) that specific revegetation or other riparian management will have on that mechanism.
- *Scale* – Size is everything! Where you are in a catchment influences both the erosion processes that operate, and the leverage that riparian vegetation has over those mechanisms. This also relates to the steepness and ‘smoothness’ of a catchment and the efficiency by which water enters waterways.
- *Time* – the interaction between the vegetation and the erosion mechanisms will change with time as the vegetation grows, and as the vegetation alters other aspects of the system.

Most erosion can be resolved by reinstating groundcover and vegetation, and by removing the threats to these by fencing and replanting. In the case of large-scale erosion, it is best to seek professional advice from erosion experts. In many cases where erosion may seem catastrophic, assessment and planning can identify the few important active areas that need to be addressed.

2.2.3 Loss of Riparian Vegetation and Connectivity

The clearing of vegetation and degradation of soils associated with modified landscapes, such as urban and agricultural areas, can significantly impact ecosystem health. Modified landscapes increase the pollutant and sediment loads entering waterways and alter hydrology, through changes to natural drainage and river channels. The replacement of vegetation with large impervious surfaces in urban areas also increases surface run-off, which can pollute waterways with fertilisers, chemicals, organic matter, salts, soil, oil and sewage effluent. The clearing and degradation of riparian zones has resulted in the loss of crucial habitat (including instream woody debris and terrestrial habitat) and functions such as shading, channel protection, water quality management and food resources. Riparian condition in many areas has also been affected by loss of connectivity synonymous with habitat deserts created between patches.

Vegetation loss and landscape fragmentation has resulted in the loss of:

- food and shelter for wildlife.
- wildlife species.
- ecosystem processes that create clean air and water.
- infiltration of water into the groundwater table.
- temperature regulation.
- baking of soil and loss of important soil processes.

- aesthetics and recreational value.
- spiritual and cultural values.

Riparian rehabilitation needs to focus on promoting riparian vegetation; whether it is a swampy meadow or wetland consisting only of grasses and wetland plants (top photo), or a forest with a mixture of trees, shrubs, grasses and aquatic plants (bottom photo) if these losses are to be redressed.



Photo 3 (top) shows a healthy wetland and photo 4 (bottom) shows a forest dominated riparian zone.

3. About the Jerrabomberra Creek Catchment

3.1 Overview

The Jerrabomberra Creek Catchment covers approximately 127 square kilometres and spans 35 kilometres north-south and 9 kilometres east-west. The catchment has a mixture of rural and urban residential developments, agricultural grazing lands and conservation areas. Land use within the Jerrabomberra Creek Catchment is however, changing, with an increase in residential development (ACT Government 2018).

The Jerrabomberra Creek originates in Royalla NSW, and flows through the localities of Fernleigh Park, Jerrabomberra, Symonston and Narrabundah, before terminating in the East Basin of Lake Burley Griffin via the Jerrabomberra Wetlands. Tenure and land management responsibilities are complex and are outlined in Section 5. However, in order to create a plan for the future it is helpful to gain a knowledge of the past.

3.2 Looking Back in Time

Jerrabomberra Creek and its catchment form part of the traditional lands of the Ngunnawal people. Ngunnawal territory extends across the southern tablelands and is bounded by other traditional lands and language groups. These include: the Ngarigu/Ngarigo People whose lands stretch from the highlands to the south coast; the Yuin People on the coast to the east of Canberra; the Wiradjuri People on the slopes and plains to the west of Yass; and the Gundungurra People immediately to the north (MCG 2015). Major creek or river junctions ensure that there is a plentiful supply of food and water on flood plains, while the slopes of the surrounding hills and ridges provide shelter (MCG 2015). The Jerrabomberra Creek Catchment has a rich Aboriginal history evidenced by artefacts, scar trees and local knowledge (Gould *pers. obs.* 2019).

Governance in the Molonglo Catchment began as an Indigenous system that, although not written down, was codified within Aboriginal cultural practise and lore, resulting in a plentiful food supply and healthy ecosystem. Whilst Aboriginal consultation in cultural and some peripheral areas of landscape management have been acknowledged, we are yet to realise the potential for creating new shared knowledge via meaningful partnerships.

Europeans first began to settle in the region soon after their arrival in Australia, and Queanbeyan was officially proclaimed in 1838. At this time, the Jerrabomberra Creek Catchment was a chain of ponds system with ephemeral flows and rich alluvial flats in the riparian zones. Gammage (2011) makes reference to the Molonglo Catchment region a number of times throughout his book, including Hoddle's 1832-35 travels in the Canberra region, which provide an insight into the landscape during early European settlement:

'In 1832-5 Robert Hoddle soon to survey Melbourne, surveyed between Yass and Michelago, including Canberra and Queanbeyan. "Open plains" and fine open grassy forest" without undergrowth were easily most common, and commonly alternated...Kangaroo Grass and Blakely's Red Gum, Ribbon Gum or Apple Box dominated, with Yellow Box on lighter soils, and wattle or casuarina in places. Hoddle marked no dense forest, not even on hills thickly forested now, and only two 'scrubby' places, one on hills south of Lake George, one east of Jerrabomberra Creek towards Burra. Another scrub belt...bordered the northeast corner of the airport plain. Scrub undergrowth now typifies Australian Capital Territory bush.'

Almost all watercourses in the Molonglo Catchment region were chains of ponds, including the Queanbeyan and the Molonglo with 'large ponds holding fish, eel, platypus and yabbies', and grassland either side. A painting by Hoddle from 1832 shows the hills and ranges of the Ginninginderry Plains with only sparse grassy woodlands, which are today densely forested. Some of the trees even appear to be in lines across the landscape. All this is offered as evidence that this was a landscape managed by fire (Gammage 2011).

Aboriginal camping, and local and regional Corroborees still occurred in and around large rural properties or local towns, such as Queanbeyan, into the 1860s, albeit intermittently and generally in association with annual government blanket land distributions. By that time Aboriginal people were displaced and their presence and numbers in the townships were greatly reduced.

Today, the Jerrabomberra Creek and surrounding catchment is significantly different from these early accounts. It is now an incised channel with eroded gullies and tributaries (Maunsell Australia Pty Ltd & Queanbeyan City

Council 2006). Native vegetation has been altered by clearing for agriculture and urbanisation, and by the introduction of exotic plants and animals. The areas that remain largely intact are important natural assets and include significant areas of Endangered Ecological Communities (EEC) such as Natural Temperate Grassland and Box Gum Woodland. There are still some stretches of the Jerrabomberra Creek that remain in a natural state.

The Jerrabomberra Catchment has a mixture of land uses, incorporating rural residential (lifestyle), grazing, urban areas, cottage industries, conservation and industry. Being so close to Canberra, the upper parts of the catchment are populated, and this is likely to continue, as evidenced by several new land developments in the Jerrabomberra, and nearby Burra Creek, Catchments. Developments of this nature can have both positive and negative outcomes for the integrity of the landscape. In many cases, rural residential areas attract people that have little land management experience; and higher numbers of people independently managing smaller lots can make water quality and biodiversity protection more complex.

In contrast, however, there are some rural residential who have transformed the landscape through native planting, weed removal and erosion control works. These activities are driven by a strong Landcare network and influential individuals. For example, in the Royalla area a 'Vegetation Investment Project' began in 2000 that offered incentives for planting and protection of remnant vegetation, to protect and enhance habitat for the Hooded Robin (as a flagship species for many other declining woodland birds). A minimum of 10 hectares of land was required for impact. In most cases, however, landholdings were less than this. In response, the Royalla community chose to work together, driven by local champion Maryke Booth. The outcomes included the protection and enhancement of hundreds of hectares of remnant bushland, and the Royalla Landcare Group have continued their work, transforming the headwaters of the Jerrabomberra Creek Catchment.

Similarly, there are examples of the positive outcomes of community action in pockets throughout the entire catchment. These include a range of activities to fence and revegetate creeks, connect vegetation, provide habitat, undertake soil erosion works, control problem willows, combat weeds and feral animals, and trial the use of fire for biomass and grasslands management. Projects have been undertaken by Queanbeyan Landcare, Fernleigh Park, Molonglo Catchment Group, Greening Australia, Queanbeyan Palerang Council (previously two separate councils), ACT Government, Wandiyali Conservation Trust, Catchment Groups, Local Land Services and others. Although Traditional Owners have been consulted and engaged in various projects, there is an ongoing need to better incorporate traditional land management practises at the broader scale and to work together to integrate knowledge.

3.3 Our Natural Assets

3.3.1 Vegetation

Prior to European settlement, vegetation within the Jerrabomberra Creek Catchment consisted of dry sclerophyll forest on the steep slopes, sparse open woodlands on the undulating hills and expanses of native grasslands on the flatter, colder valley floors.

Since European settlement, the vegetation in the catchment has changed significantly, particularly in the absence of fire. Some rural areas now tend to be dominated by pasture grasses and in urban areas vegetation has been removed. Despite this, there remains some notable large expanses of native pasture grasses and significant pockets of remnant vegetation comprising a diversity of grasses, shrubs and mature trees. The condition of this vegetation is of high quality.

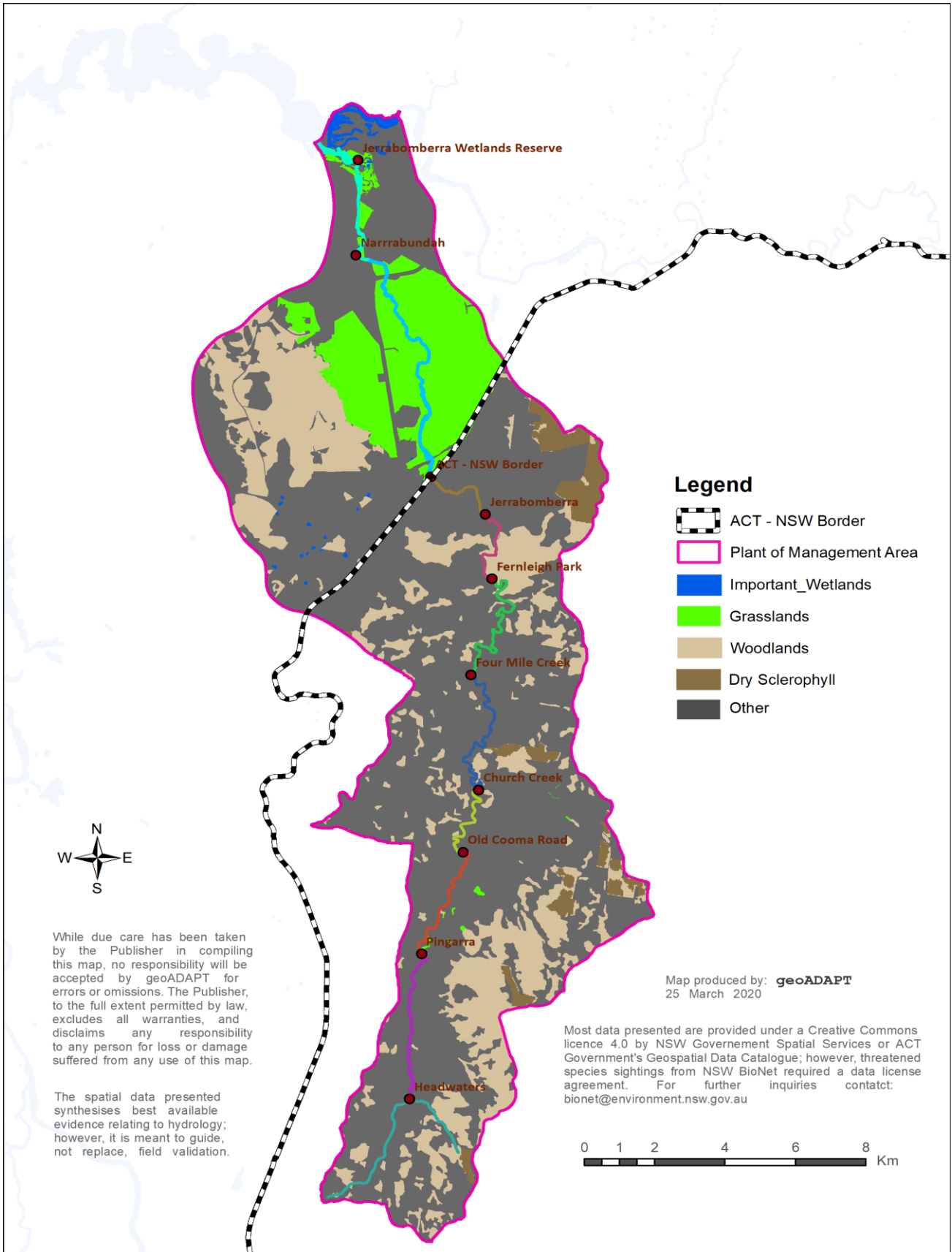
One such 'pocket' exists at 'Wandiyali' to the south east of the ACT, which is a 400-hectare sanctuary, managed solely for conservation of biodiversity values. The area has a mixture of intact Box Gum woodland, dry sclerophyll forest and a relatively intact section of the Jerrabomberra Creek. Although previously a grazing property, the sanctuary is in excellent condition and provides a useful reference site upon which to base rehabilitation works in other areas. More information can be found at <https://www.facebook.com/Wandiyali/>

Native vegetation in the region falls into three broad categories:

- Dry Sclerophyll Forest - key species: *E.macrorhycha*, *E.dives*, *E.mannifera*, *E.rossii*, *Joycea* /*Rhytidosperra*, *Poa*.
- Box Gum Woodlands - key species: *E.meliadora*, *E.blakelyi*, *E.polyanthemos*, *E.bridgesiana*, *E.nortonii*, *E.goniocalyx*, *Hibbertia*, *Melichrus*, *Leucopogan*.

- Grasslands - key species: *Stipa*, *Themeda*, *Bothriocloa*, *Danthonia*, *Elymus*.

There are also numerous ecotones between these communities which may display a mixture of species that dominate a given community, as well as other smaller pockets of different vegetation types such as Snow Gum / Ribbon Gum woodlands. Map 2 shows the vegetation communities in the Jerrabomberra Creek Catchment.



Map 2 Vegetation Communities within the Jerrabomberra Catchment

The Molonglo Conservation Group (formerly Molonglo Catchment Group) compiled a series of species lists for the different sections of the Jerrabomberra Creek and this can be found at:

[Plant Guide - Jerrabomberra Creek.pdf \(molonglo.org.au\)](http://molonglo.org.au)

3.3.2 Geology and Soil

Much of the ACT is underlain by rocks formed from sediments deposited 460 million years ago when the region was under the sea. These sediments are sandstone, limestone, siltstone and shales—rocks that are part of the Palaeozoic Lachlan Fold Belt that stretches from central NSW to Victoria (MCG 2015). Jerrabomberra Creek comprises soil derived from (predominantly) granite, although there are also some sedimentary rocks and alluvial soils underlying a small part of the suburb of Jerrabomberra and downstream into the ACT (Maunsell & QCC 2006). Vegetation clearing and grazing practices of early European settlers, together with rabbit plagues and urban development, have contributed to gully and bank erosion which means that Jerrabomberra Creek now carries significant amounts of sediment (Maunsell & QCC 2006).

The landscapes of the catchment reflect various geological events, the long-term effects of weather and climate, and the influences of human settlement. The three broad landscape types, are:

1. Uplands (areas at altitudes above 800 metres): The uplands lie mainly on erosion-resistant, ancient, sedimentary rocks and granites. Most of the upper parts of the catchment fall into this category.
2. Rolling or undulating country (usually 600–900 metres): These areas are formed across moderately weathered rocks, and account for most of the mid catchment. The country is crossed by minor streams.
3. Plains (550–650 metres): These areas occur along the lower sections of Jerrabomberra Creek Catchment where the landscape flattens out. They were once swampy meadows and ‘chain of pond’ creeks that have, in most cases, become channelised or modified by urban development. (MCG 2015)

Soil depth is in the range of 40–60 cm before grading to weathered shale bedrock. The exception is terrace and alluvial flats, which display light-grey coloured, silty, loam topsoil to a depth of 30–50 cm, sharply overlying a yellowish coloured clay loam to light clay subsoil. Discontinuous layers of gravel are also a feature of these soils, reflecting their formation in a depositional environment. Total soil depth of the yellow podzolics is variable, but generally doesn’t exceed 1–1.5 metres (Jenkins 2000).

Most soils in the catchment are very low in phosphorous and nitrogen, and also vary in pH and salt levels. Many subsoils are sodic and display a high content of magnesium relative to calcium. This can create soil instability and erosion, as well as specific problems such as soil erosion by water, soil structure decline (sodicity and waterlogging), soil acidity and soil fertility decline. Currently, degradation at both the local and regional level is undermining the values of soils.

According to Hydrogeological Landscape (HGL) mapping (Wooldridge 2015), the salinity hazard in the upper parts of the catchment around Royalla is moderate, and low for the lower parts of the catchment around Symonston.

3.3.3 Water

a) Surface Water

Jerrabomberra Creek is an unregulated stream that originates in the hills surrounding the rural residential area of Royalla, south-east of the ACT border. Unregulated means that flow is in a mostly natural pattern and not controlled by infrastructure for water storage or water extraction. From Royalla, the creek flows through larger, private, rural landholdings; which are used for a mixture of agriculture, lifestyle and conservation; until it reaches the rural residential area of Fernleigh Park and the urban area of Jerrabomberra. It then flows through the Jerrabomberra grasslands and the suburb of Narrabundah, before meeting Lake Burley Griffin at the Jerrabomberra Wetlands.

Surface water quality for the Jerrabomberra Creek catchment is rated as ‘good’ in the upper reaches (Headwaters to Fernleigh Park) and ‘fair to good’ in the lower reaches (Fernleigh Park to the Molonglo River Confluence at Lake Burley Griffin). Indicators such as riparian condition, electrical conductivity (salinity) and dissolved oxygen have been recorded as ‘poor’ for many years. Water bugs in the lower reaches also remain

‘poor’, however, they are recorded as ‘mostly good’ in the upper reaches. Tables 1 and 2 show water quality monitoring results for the upper and lower parts of Jerrabomberra Creek each year from 2014–2020 (modified from CHIP (Catchment Health Indicator Program) reports 2014–18 compiled by Waterwatch).

Table 1 Water Quality Results, Jerrabomberra Creek, Headwaters to Fernleigh Park

| Indicator | 2019-2020 | 2018 | 2016–17 | 2015–16 | 2014–15 |
|-------------------------|-----------|-----------|-----------|-----------|-----------|
| Overall Rating | B | C+ | B- | C+ | B |
| Water quality | Good | Good | Good | Good | Good |
| pH | Excellent | Excellent | Excellent | Excellent | Excellent |
| Turbidity | Excellent | Good | Excellent | Excellent | Excellent |
| Phosphorus | Excellent | Excellent | Excellent | Excellent | Excellent |
| Nitrate | Good | Excellent | Excellent | Excellent | Good |
| Electrical Conductivity | Poor | Poor | Poor | Poor | Poor |
| Dissolved Oxygen | Degraded | Degraded | Degraded | Degraded | No data |
| Water Bugs | Good | Good | Good | Fair | Good |
| Riparian condition | Fair | Poor | Poor | Poor | Poor |

Table 2 Water Quality Results, Jerrabomberra Creek, Fernleigh Park to Molonglo River (Lake Burley Griffin)

| Indicator | 2019-2020 | 2018 | 2016–17 | 2015–16 | 2014–15 |
|-------------------------|-----------|-----------|-----------|-----------|-----------|
| Overall Rating | C+ | C+ | C | C+ | C+ |
| Water quality | Good | Good | Fair | Good | Fair |
| pH | Excellent | Excellent | Excellent | Excellent | Poor |
| Turbidity | Fair | Good | Fair | Fair | Fair |
| Phosphorus | Excellent | Excellent | Degraded | Excellent | Degraded |
| Nitrate | Excellent | Excellent | Good | Excellent | Excellent |
| Electrical Conductivity | Poor | Poor | Poor | Poor | Poor |
| Dissolved Oxygen | Degraded | Degraded | Degraded | Degraded | Degraded |
| Water Bugs | Fair | Fair | Fair | Fair | Good |
| Riparian condition | Poor | Poor | Poor | Poor | Poor |

Assessing trends in water quality over time is useful to help to understand where to invest resources to address priority issues. Water quality in the upper sections of Jerrabomberra Creek fluctuate between B- rating and C+ which means it obtains a ‘good’ rating. Riparian condition appears to have improved slightly in 2020. By contrast, the downstream remained relatively stable with a C+ rating. Water quality in the upper reaches is better than downstream reaches, however there is still a lot of room for improvement, particularly in the case of riparian condition, which if addressed will also improve the water bug score.

Additional monitoring of macroinvertebrates is also undertaken by the ACT government, however there is only one site along Jerrabomberra Creek. This was located at Hindmarsh Drive and was sampled from 2005 to 2012. These results were highly variable with measurements ranging from a B (good) to a D (extremely impaired) between seasons. More sites would need to be monitored more frequently to obtain a clearer picture at the broader creek scale of what is happening at this site, and in particular, whether there is any improvement downstream of protection and habitat works.

b) River flows

Any alteration to river flows can change the natural morphology of rivers. Water reservoirs and weirs cause significant alteration to the timing and volume of natural flow regimes and are barriers to the movement of fish and other species. Changes to natural flows are particularly detrimental for species with life-cycle stages that are intimately linked to seasonal flow changes. In addition to flow alteration, reservoirs can cause thermal pollution through the release of cold water, which can impact on biodiversity. Other impacts on river flows include channel modifications which prevent the duration and frequency of flooding.

The impacts of modified flow regimes are compounded by the occurrence of drought. Extended periods of reduced flows can lead to increased water temperatures (especially where riparian vegetation has been cleared), degraded water quality and increased risk of algal blooms. These have negative consequences for

biodiversity and agriculture (livestock). Extended dry conditions can also result in habitat loss and depleted biodiversity on the edges of water systems.

Bushfires, which are becoming more frequent in a drying climate, remove vegetation cover, exposing and altering the structure of soils and increasing the risk of significant erosion. Consequently, rainfall and run-off after bushfires can deposit large volumes of sediment and ash into aquatic ecosystems.

c) Groundwater

Groundwater within the Jerrabomberra Creek Catchment is of good quality, with salinity levels in the deeper fractured rock aquifer at acceptable levels (Maunsell & QCC 2006). Use of groundwater in NSW within the catchment is generally limited to livestock and domestic use in the suburbs of Royalla and Googong, but information on groundwater use is difficult to find. Similarly, the 2019 State of the Environment (SoE) report for the ACT states that information on groundwater availability and quality is limited; therefore, it is difficult to assess groundwater state and trends. It is estimated that the extraction rate is no greater than 10% of the long-term recharge. Information on other potential groundwater contaminants is largely absent, and usually only collected at specific times and locations. One potential area of future concern is nitrogen levels in groundwater. High connectivity between surface water and groundwater could mean that, over time, the high levels of total nitrogen observed in many waterways of the ACT could infiltrate into groundwater aquifers, with serious ecological consequences and human health issues. This would only be of concern if groundwater use increases in the future (SoE 2019).

3.3.4 Biodiversity

Biodiversity in the Jerrabomberra Creek Catchment is extremely high, and although biodiversity outcomes often focus on the variety of vegetation, there are many other elements that make up functioning ecosystems. These include rocky outcrops, woody debris (of all sizes), loose rocks, diverse topography (from valley floors to steep gorges), wetlands, ponds, creeks, ephemeral gullies, different soil types, urban parks and tree-scaping. This diversity in habitat supports a large diversity of wildlife from the bacteria and fungi in the soil through to larger mammals.

As land managers and Natural Resource Management (NRM) practitioners, people often focus on threatened species and communities as a priority target for action, however, these landscapes also support an array of other wildlife. These include Echidnas, Platypus, Rakali, Kangaroos, Wallabies, at least six species of frogs, hundreds of birds, Skinks, Snakes, Monitors, Dragons and the plethora of insects that play highly critical roles in food webs. Little is known about native fish in the catchment, with no records in Canberra Nature Map or elsewhere. This doesn't mean they are not there, but instead have not been surveyed. Users of 'Bonzle' (a user-driven digital atlas which records detailed information about locations around Australia), claim to have seen and/or caught carp, Golden perch, Murray cod, Redfin, Silver perch and Yabbies from Jerrabomberra Creek. Fish diversity is a gap in knowledge that needs to be filled, as well as gaining knowledge about the insects that are vital for functioning food webs. Given the high level of biodiversity, Jerrabomberra Creek Catchment would be suited to a community bioblitz.

3.3.5 Threatened Entities

This section outlines the numerous threatened entities in the Jerrabomberra Creek Catchment, including Endangered Ecological Communities.

a) Box Gum Woodlands

While many threatened species and ecological communities are protected in conservation areas, some are not, for example, Yellow Box / Red Gum Grassy Woodland. The lack of protection adds to the pressures on these communities and the species they support as they tend to occur on farmland, and areas of rural residential and urban development. Box Gum woodland is a key vegetation community type in the Jerrabomberra Creek Catchment, with large areas of vegetation still intact, as well as patches of scattered trees on agricultural and rural residential properties in a modified condition.

b) Natural Temperate Grasslands

Natural Temperate Grassland is one of the most threatened natural plant communities in Australia. Before European settlement, these grasslands were thought to cover 11% of the ACT area, but today they occupy less than 1% (Hodgkinson 2014). This ecosystem was well suited to settlement, in particular agriculture and urban development, due to the abundance of grass and the absence of trees respectively. Remaining grasslands are highly fragmented and are often degraded with ongoing threats such as the spread of exotic plant species, and land use change (Hodgkinson 2014).

The ACT has some of the largest, best quality and most connected patches of Natural Temperate Grassland remaining in south-eastern Australia, with most of these protected in nature reserves, including those at Jerrabomberra Grasslands through which the Jerrabomberra Creek flows. Protection alone is not, however, enough to conserve their unique biodiversity, which has evolved alongside frequent disturbance from both fire and grazing. In the absence of these disturbances, plant biomass can accumulate, leading to weed invasion, reduced cover of native grasses, decline in productivity, loss of plant diversity, and simplification of grass structure. They need to be actively managed. Fire was a tool used to manage land by Indigenous peoples and since settlement it has been largely absent across ACT grasslands, although some small-scale burns undertaken by Traditional Owners in partnership with the Ginninderra Catchment Group and the ACT Parks and Conservation Service, have shown that fire can improve ecological values (noting that there are many unknowns about the impact of fire on certain plant communities and threatened fauna in the contemporary 'post-settlement' world).

This sets an important context for this plan, as Jerrabomberra Creek flows through a significant patch of remnant native grassland at Jerrabomberra East, which hosts a population of Grassland Earless Dragons and a number of other threatened species. More information can be found on this in Section 7 which provides an implementation plan for each section of creek.

c) Threatened Species

The Jerrabomberra Creek Catchment has a large number of threatened species due to the diversity of habitat types and many high conservation value areas. Table 3 provides a list of these.

Table 3 Threatened Species Jerrabomberra Catchment (Source: NSW Bionet and ACT Government records)

| Fauna | Flora |
|--|--|
| Grassland Earless Dragon (<i>Tympanocryptis pinguicolla</i>) | Button Wrinklewort (<i>Rutidosis leptorrhynchoides</i>) |
| Pink-tailed Legless Lizard <i>Aprasia parapulchella</i> | Ginninderra Peppercross (<i>Lepidium ginninderrense</i>) |
| Striped Legless Lizard (<i>Delma impar</i>) | Hoary Sunray (<i>Leucochrysum albicans</i>) |
| Perunga Grasshopper (<i>Perunga orachea</i>) | Silky Swainson-pea (<i>Swainsona sericea</i>) |
| Golden Sun Moth (<i>Synemon plana</i>) | Small Purple-pea (<i>Swainsona recta</i>) |
| Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>) | Medusa Bogsedge (<i>Schoenus latelaminatus</i>) |
| Large Bent-winged Bat (<i>Miniopterus schreibersii</i>) | |
| Brown Treecreeper (<i>Climacteris picumnus victoriae</i>) | |
| Diamond Firetail (<i>Stagonopleura guttata</i>) | |
| Dusky Woodswallow (<i>Artamus cyanopterus</i>) | |
| Flame Robin (<i>Petroica phoenicea</i>) | |
| Hooded Robin (<i>Melanodryas cucullata cucullate</i>) | |
| Little Eagle (<i>Hieraetus morphnoides</i>) | |
| Scarlet Robin (<i>Petroica boodang</i>) | |
| Speckled Warbler (<i>Pyrrholaemus sagittatus</i>) | |
| Varied Sittella (<i>Daphoenositta chrysoptera</i>) | |

3.4 Our Changing Climate

There has been an increasing warming trend, both locally and nationally, with Australia’s climate warming by 0.9°C since 1910 (Bureau of Meteorology & CSIRO 2014). Climate change exacerbates existing pressures on aquatic ecosystems. Reduced rainfall (including snowfall), hotter temperatures and increased evapotranspiration all have severe consequences, including:

- reduced river flows and reduced wetland inundation.
- reduced deep water habitat refuge.
- higher water temperatures and lower dissolved oxygen concentrations.
- extended dry periods punctuated by severe storms which result in large nutrient, sediment and other pollutant pulses.
- increased algal blooms.
- more frequent and severe bushfires which compromise water quality and riparian vegetation.

Although the aquatic species of the ACT are well-adapted to extremes of floods and droughts, these events are projected to intensify under climate change, pushing some species and communities beyond their ability to adapt. In the long-term, the pressures of climate change on freshwater ecosystems could lead to significant and long-lasting changes in the species present in the ACT’s rivers, lakes and wetlands. Figure 1 illustrates climate change projections for the ACT.

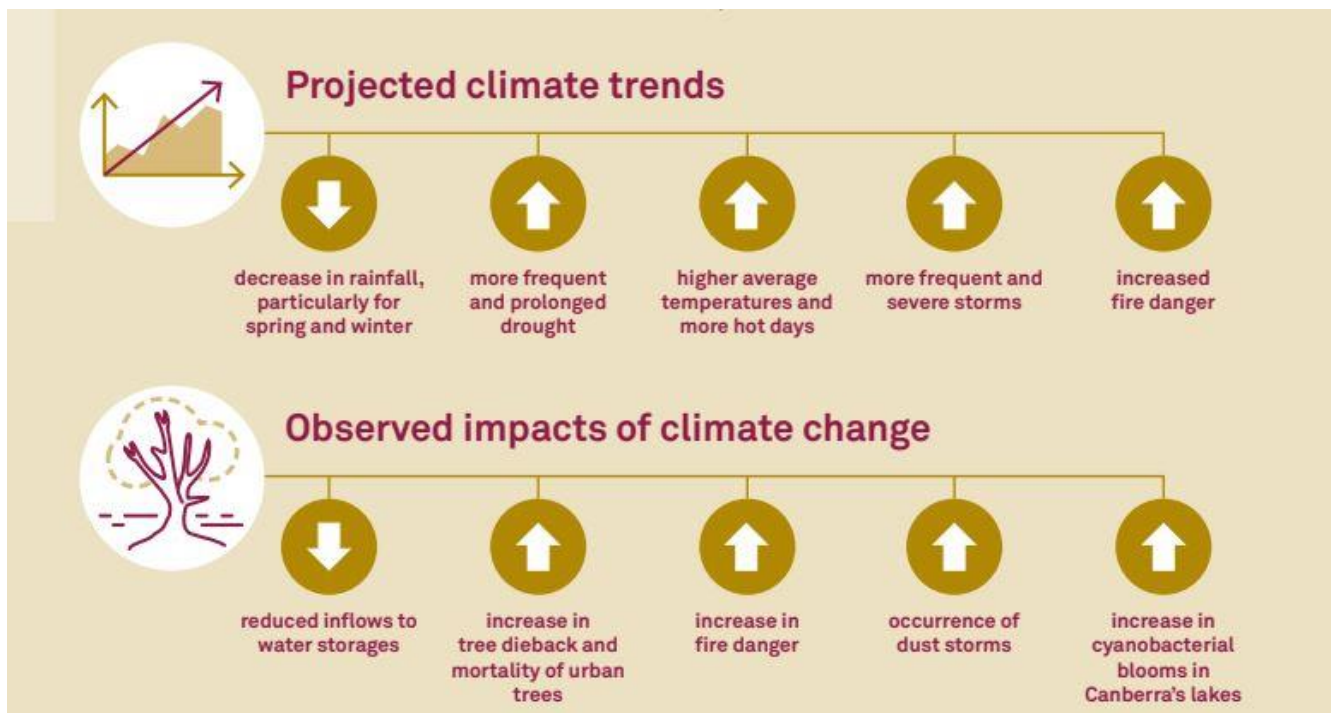


Figure 1 Climate Change projections for ACT region (Commissioner for the Environment 2019)

3.5 Human Use of the Catchment

Human activities dominate the landscape in the Jerrabomberra Creek Catchment. What was once a landscape of scattered woodlands, grasslands and swampy meadows, interspersed by steep forested hilltops managed by the Ngunnawal People, has been transformed. European settlement resulted in broadscale agriculture, mostly in the form of grazing. Associated activities included clearing of vegetation, ploughing paddocks for pasture improvement, realignment of drainage channels and the introduction of exotic animals.

The next major transformation to the natural assets of the catchment has been residential development with a combination of rural and urban housing which continues to occur at a fast rate. Development means more people, resulting in greater pressure on natural resources, in particular, soil and water. To counter this, there have been a number of alterations to the flow of Jerrabomberra Creek in the form of lakes and filtration beds to improve water quality and create areas for recreation and amenity.

4. About the Community

The Jerrabomberra Creek Catchment has a large number of stakeholders, including ACT and NSW governments, individual landholders, community groups, Indigenous organisations, businesses, NGO's, urban residents, Council, and Wandiyali Conservation Trust. These stakeholders and their primary involvement in the Jerrabomberra Creek Catchment are outlined in Table 4 below (in alphabetical order). This list is not exhaustive and remains open and flexible to accommodate a range of initiatives as the plan is implemented. Most consortium members already work together due to existing relationships and, with their help, a great deal has been achieved in the catchment already.

Table 4 Jerrabomberra Creek Stakeholders

| Group | Description / Context | Involvement |
|--|---|--|
| <p><i>Aboriginal Traditional Custodians</i></p> <p>Examples of partners that have in the past and/or continue to engage with activities in the catchment:</p> <ul style="list-style-type: none"> ~ Traditional Owners Aboriginal Corporation ~ Clybucca Dreaming ~ Yurbay Consulting ~ Dreamtime Connections ~ Culture on the Move ~ Buru Ngunawal Aboriginal Corporation ~ Blake Canackle ~ Aunty Narelle ~ Dharwa Tours ~ Cathy Freeman Foundation ~ Indigenous Conservation Volunteers | <p>In present day Canberra, there are Indigenous people from 'Nations' all over Australia who are engaged in a range of initiatives in the Jerrabomberra Creek Catchment and the region more broadly; they do so with respect and acknowledgement of the Ngunawal People as Traditional Custodians. It is on this basis that this Catchment Plan intends to operate.</p> | <ul style="list-style-type: none"> • Traditional land management advice including management of cultural sites. • On-Country activities. • Interpretation. • Connection to Country. <p>The intent is to work with anyone who wants to engage and to remain flexible with how that may develop over time.</p> |
| <p><i>ACT Government Lessees</i></p> | <p>There is opportunity for strategic grazing and riparian rehabilitation on leasehold land through education and incentive programs, in partnership with the ACT Government.</p> | <ul style="list-style-type: none"> • Sustainable land management practises. • Rehabilitation activities as relevant. |
| <p><i>ACT Parks and Conservation Service (PCS)</i></p> | <p>The key agency responsible for management of nature reserves along the creek, including the management of endangered communities, such as the Jerrabomberra Grasslands, and species, such as the Grassland Earless Dragon and others. Is also manages the nationally important Jerrabomberra Wetlands, which provides habitat for over 200 species of birds and other wildlife. The PCS Offsets team initiated the Jerrabomberra Creek</p> | <ul style="list-style-type: none"> • Development of Jerrabomberra Creek Catchment Plan. • Management of PCS sites including the Grasslands Project, the Jerrabomberra Wetlands and all threatened entities. • Implementation of works within the ACT and in partnership in NSW. |

| | | |
|---|---|---|
| | Masterplan and engaged the Australian River Restoration Centre to develop it in consultation with other stakeholders. | |
| <i>Alexander Maconachie Centre (AMC)</i> | The Alexander Maconachie Centre adjoins the Jerrabomberra Grasslands through which the Jerrabomberra Creek flows. There are opportunities for pre-release inmates to be involved in on ground works. They already participate in programs at Jerrabomberra Wetlands, and this could be expanded to other sites. | <ul style="list-style-type: none"> • Connection to culture activities. • On ground works. • Growing plants for projects. |
| <i>Australian River Restoration Centre (ARRC)</i> | A non-government organisation well-placed to bring consortium partners together to work towards a shared goal. The ARRC has a demonstrated ability to not only bring people together to achieve great things, but to do it in a practical way with maximum buy-in, along with the promotion of environmental and social outcomes. The ARRC would work closely with the Molonglo Catchment Group to implement actions and source funding from both ACT and NSW funding bodies. | <ul style="list-style-type: none"> • Development of Jerrabomberra Creek Catchment Plan. • Overarching organisation to guide implementation of the Plan in partnership with other stakeholders, in particular PCS and the MCG (see below). |
| <i>Friends of Jerrabomberra Wetlands</i> | Undertake on ground works and other activities at the Wetlands as part of the ParkCare Program. | <ul style="list-style-type: none"> • Continue to undertake on-ground works at the Jerrabomberra Wetlands. |
| <i>Frogwatch</i> | A community network of volunteers who survey native frogs across hundreds of sites around the Canberra region. New areas of interest could be identified. | <ul style="list-style-type: none"> • Continue to monitor frogs in the Jerrabomberra Creek catchment. • Expand on the monitoring already being undertaken through targeted training in partnership with MCG and other community groups. |
| <i>Fyshwick Businesses</i> | Both heavy metals and phosphates are issues of concern for the Jerrabomberra Wetlands (downstream of Fyshwick) and a number of initiatives have been implemented as part of the ACT Government's 'Healthy Waterways' program (co-funded by the Murray Darling Basin Authority) including an education campaign. | <ul style="list-style-type: none"> • Involvement in various activities as part of business operations. • Awareness raising. |
| <i>Greening Australia</i> | An NGO that is skilled at implementing on ground activities with landholders and community and has expertise in revegetation and plants more broadly. | <ul style="list-style-type: none"> • Provision of services in revegetation, project implementation, and engagement of landholders. |
| <i>Molonglo Conservation Group (MCG)</i> | A major partner in the planning and implementation of the Masterplan that works across both NSW and the ACT and has connections to a number of landholders and other stakeholders in the Jerrabomberra Creek Catchment. MCG is also highly experienced in the implementation of a variety of environmental projects including those with a riparian focus. | <ul style="list-style-type: none"> • Coordination of the implementation of the Jerrabomberra Creek Catchment Plan in partnership with PCS and the ARRC. • MCG works across both the ACT and NSW, has considerable buy-in with the local community and other stakeholders, and has demonstrated expertise in |

| | | |
|--|--|--|
| | | <p>managing and implementing projects.</p> <ul style="list-style-type: none"> • Training and education. • Consulting. • Delivery of part of the 'Healthy Waterways' program on behalf of ACT Government. |
| <i>Molonglo Group and Eastlake Developers</i> | Developers who could be engaged to provide support for implementation of the Plan. They already have an interest in the Jerrabomberra Wetlands. | <ul style="list-style-type: none"> • Community liaison. • Sponsorship for projects and programs (in particular the Latham's Snipe project). |
| <i>National Capital Authority</i> | Commonwealth agency that manages Lake Burley Griffin (the termination point of Jerrabomberra Creek) | <ul style="list-style-type: none"> • Approvals for capital works in Australian Government areas. |
| <i>Royalla Landcare</i> | A cohesive and active community group that has been undertaking riparian rehabilitation along the headwaters of Jerrabomberra Creek for many years and has achieved some great outcomes for water quality and biodiversity. The group also have a very strong and active Landcare network. | <ul style="list-style-type: none"> • Network for communication in the Royalla area (headwaters of the catchment). • Landholder engagement • Delivery of projects / implementation of on-ground works • Training and education |
| <i>Small Farms Network Capital Region</i> | The Small Farms Network Capital Region is a grassroots information service run by small farmers for small farmers. They work with any rural property including bush blocks. | <ul style="list-style-type: none"> • Networking. • Project implementation (partnership). • Communication with landholders. |
| <i>Urban Residents (primarily from Jerrabomberra, Narrabundah and Kingston).</i> | There are opportunities to get support and engagement from residents along the Jerrabomberra Creek and the Kingston Foreshore (as neighbours). Examples may include community get-togethers, 'Adopt-a-Patch' volunteers, 'citizen science' and so on. Old Narrabundah Community Council (ONCC) and their care of Jerrabomberra creek and new wetlands provides a good example of this. | <ul style="list-style-type: none"> • Volunteering. • Advocacy. • Citizen science. |
| <i>Waterwatch</i> | A community network of volunteers who collect data from 4 sites along the Jerrabomberra Creek at present, but could increase this to include specific areas of interest (e.g. above and below in-stream works). | <ul style="list-style-type: none"> • Continue to monitor water quality in the Jerrabomberra Creek Catchment. • Engage volunteers in other activities occurring in the catchment as appropriate (communications, invitations to be involved in on-ground works, citizen science and so on). |
| <i>Woodlands and Wetlands Trust</i> | This group oversees implementation of activities at the Jerrabomberra Wetlands in partnership with PCS and has implemented a number of projects to improve and protect habitat. The group also runs successful community engagement programs which provide educational opportunities for the broader Canberra community. | <ul style="list-style-type: none"> • Implementation of programs at Jerrabomberra Wetlands. • Coordination of the 'Culture Talks' Program which could extend to the whole catchment. |

5 Planning Framework and Legislation

Legislation, planning and key actions for management of various aspects of the Jerrabomberra Creek Catchment are outlined in numerous plans and strategies which are implemented and / or governed by various agencies. In the ACT, the government manages both local and state functions, whereas in NSW they are separated into local and state government responsibilities. The ACT is impacted by, and contributes to, the policy and regulatory interventions in neighbouring NSW jurisdictions within a framework of complex, multifaceted, non-linear policy (SoE 2019).

It is useful to understand this regulatory and legislative complexity as it highlights the need for careful planning to ensure that on-ground decisions within this cross-jurisdictional catchment are clearly articulated and supported by Government agencies. The following is a brief history of catchment planning to set the scene for the implementation of the new Jerrabomberra Creek Catchment Plan.

5.1 History of Planning

As environmental awareness grew more prominent in the 1980s, and in particular, the plight of our waterways, there was a push towards catchment-scale management of land and water. The *NSW Catchment Management Act 1989* was partly responsible for the establishment of the Murrumbidgee Catchment Management Committee (MCMC), which in 1992 established the Upper Murrumbidgee Catchment Coordinating Committee (UMCCC) who released the Murrumbidgee Catchment Action Plan (MCAP). This enabled local agencies and communities to work towards a common set of objectives.

In an ever-evolving political environment, the *NSW Catchment Management Act 1989* was repealed and replaced with the *Catchment Management Authorities Act 2003*. The UMCCC became an incorporated association, and the MCMC transformed to become the Murrumbidgee Catchment Management Authority (MCMA). The MCMA developed the Murrumbidgee Catchment Management Blueprint in 2003 which then became the foundation for the Murrumbidgee Catchment Management Plan (MCAP) finalised in 2008. This generation of catchment planning was characterised by an asset management approach to planning, and the formulation of associated targets and actions. In the ACT, a Natural Resources Management Plan was developed in 2004 and updated in 2009, titled *Bush Capital Legacy: A Plan for Managing the Natural Resources of the ACT*. It shared the same regional targets as the NSW plan (ACT Natural Resource Management Council 2009).

In 2013, there was another significant change to the way in which natural resources were managed across NSW, with Livestock Health and Pest Authorities (LHPA), Catchment Management Authorities (CMA), and extension services of the NSW Department of Primary Industries (DPI) rolled into one organisation called Local Land Services (LLS). These new organisations did not follow catchment boundaries but were aligned with local government areas. The focus of Local Land Services regional bodies has meant that catchment action plans have become less relevant (although still useful for forward planning due to the level of research and planning that had been invested in them) and are now being replaced with the Sustainable Land Management (SLM) Framework. These changes also saw the repeal of the Native Vegetation Act 2003, Threatened Species Conservation Act 1995 and the Nature Conservation Trust Act 2001 as well as animal and plant provisions of the National Parks and Wildlife Act 1974, which were replaced by the *Biodiversity Conservation Act 2016* and the *Local Land Services Act 2016*. Key features of the new SLM framework include new ways to assess and manage the biodiversity impacts of development. A new State Environmental Planning Policy (SEPP) has been developed to manage impacts on native vegetation in non-rural areas including significant investment in conserving high-value vegetation on private land; a risk-based system for regulating human and business interactions with native plants and animals; streamlined approvals; and dedicated resources to help reduce the regulatory burden (Local Land Services 2020).

Like NSW Government NRM agencies, local Councils have also experienced significant change over the past few years with the amalgamation of Councils to cover larger areas. Jerrabomberra Creek Catchment, which was formerly managed by the Queanbeyan City and Palerang Shire Councils, is now managed by the amalgamated Queanbeyan Palerang Shire Council. Local environment plans (LEP), and the information that underpins them, are currently being reviewed and redeveloped by Councils to reflect the changed boundaries.

The NSW section of the Jerrabomberra Creek (as part of the Molonglo and Murrumbidgee catchments) falls within the South East LLS area, and the ACT section within the ACT NRM region. These bodies also act as delivery agents under the regional stream of the National Landcare Program (Department of Agriculture, Water and the Environment 2020). The South East Catchment Action Plan was released in 2014, drawing on work undertaken for the MCAP, as well as other catchment plans developed by predecessors (South East Local Land Services 2014). The vision for the South East region is *'sustainable communities, profitable industries, resilient landscapes'*, with its catchment action plan containing three pillars that group similar activities under a common goal: 'People, Governance and Natural Resources'. Similarly, the ACT is in the process of updating its Natural Resources Management Plan due to be finalised towards the end of 2021.

As part of the Murray-Darling Basin, another key strategy for the ACT is 'Water Strategy 2014-44: Striking the Balance' (Environment and Planning Directorate 2014). The Strategy builds on the previous policy Think Water Act Water 2004 and is part of a range of other water initiatives, including the Basin Priority Plan.

In terms of establishing, monitoring and reviewing achievements and outcomes of all these plans, national State of the Environment reporting uses a report card style system of tracking environmental progress for a number of indicators. These report cards provide a standardised review of progress towards stated environmental goals. Local and state governments are required to report on the State of the Environment in their own jurisdictions every 5 years, which inputs to the national State of the Environment report (Australian Government 2016).

5.2 History of Planning in the Molonglo Catchment

Jerrabomberra Creek is one of the main tributaries to the Molonglo River, and much of the planning and strategic direction relevant to the creek is at the Molonglo Catchment scale. Planning for the Molonglo catchment began in 1998 with the building of a framework for stakeholder engagement and participation (MCG 2015). The foundations for this were contained within the Sustainable Water Action Management Plan (SWAMP 2000) which provided guidance on actions to be undertaken at the sub-catchment level. The SWAMP covered Jerrabomberra Creek, and provided a framework to address major, identified natural resource management issues including weeds, stormwater quality, in-stream erosion, and protection and enhancement of remnant vegetation. It also had a strong community engagement and cross-border focus and aligned with the catchment planning legislation.

The Molonglo Catchment Strategy was finalised in 2005 and provided a comprehensive and integrated management strategy that facilitated regional community-based delivery of NRM initiatives. It detailed a practical framework and included a stakeholder analysis, existing environmental works, legislation, management plans and strategies, digital data sets, research and other information to inform future planning and actions (MCG 2005). It was reviewed and updated in 2015 and continues to be used for strategic planning and implementation of activities spanning both NSW and the ACT (MCG 2015). Figure 2 shows how the Jerrabomberra Creek Catchment Plan fits within the Molonglo Catchment Strategy (landscape).

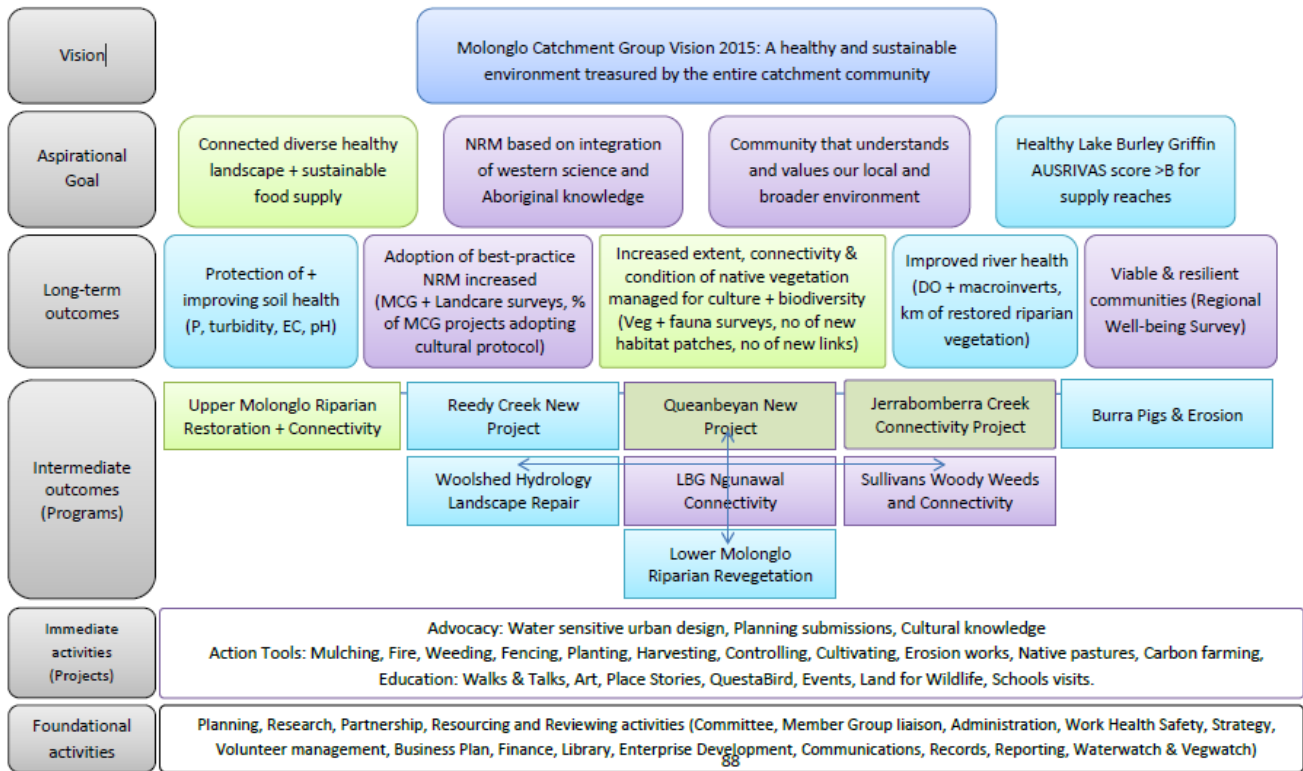


Figure 2 Molonglo Catchment Planning Strategy 2015-2025 (MCG 2015)

5.3 Jerrabomberra Creek Planning

There are numerous documents relevant the planning and development of activities in the Jerrabomberra Creek catchment covering a number of themes. The following provides an overview of the documents which are specifically relevant to Jerrabomberra Creek and catchment. A full list can be found in Appendix A.

5.3.1 Queanbeyan Palerang Council Planning Policy

Land use planning policy in Queanbeyan-Palerang Regional Council (QPRC) is managed through Local Environmental Plans, Development Control Plans, Community Plans of Management, Section 94 of the Development Contribution Plans, Local Planning Agreements, Development Servicing Plans and NSW State Environmental Planning Policies. All land within Queanbeyan-Palerang Regional Council is subject to the provisions of a local environmental plan (LEP). Currently there are seven local environmental plans, with each applying to different parts of the local government area. Work is being done on a comprehensive LEP for the whole QPRC area, which is expected to be completed by 2021. Notably, the core objectives in the LEP for management of waterways provide a good basis for waterway management more broadly.

Watercourse (Natural Area Plan of Management QCC 2010)

The core objectives for management of community land categorised as a watercourse are:

- To manage watercourses, so as to protect the biodiversity and ecological values of the instream environment, particularly in relation to water quality and water flows.
- To manage watercourses so as to protect the riparian environment, particularly in relation to riparian vegetation, and habitats and bank stability.
- To restore degraded watercourses.
- To promote community education, and community access to and use of the watercourse, without compromising the other core objectives of the category.

5.3.2 Jerrabomberra Creek Plan of Management 2006 – Queanbeyan City Council

In 2006 the Queanbeyan City Council (now amalgamated Queanbeyan Palerang Council) commissioned the Jerrabomberra Creek Plan of Management (Maunsell & QCC 2006) in response to recommendations in the 2004 State of the Environment report, which identified:

- The need for restoring Jerrabomberra Creek to incorporate endemic species.
- The inclusion of the creek in the regional Frogwatch Program.
- The establishment of additional water sampling sites on Jerrabomberra Creek (Maunsell & QCC 2006).

This report related mostly to community land along the NSW section of the creek but was extended to include catchment management activities to guide council actions. This Plan was intended to cover a 20-year timeframe, but many changes have occurred to local government since 2006, including the amalgamation of Queanbeyan and Palerang councils. It can still, however, be used as a useful reference document.

5.3.3 Jerrabomberra East and Bonshaw Grasslands

Jerrabomberra East and Bonshaw grasslands are 350ha of unleased Territory land located in the southern part of the Jerrabomberra Valley (south Canberra) which have been set aside to offset urban development and are managed within the Canberra Nature Park reserve system. This area will have an Offset Management Plan developed and it is likely to be gazetted as a nature reserve in future. Jerrabomberra Creek and a number of tributary drainage lines run through the Jerrabomberra East and Bonshaw grassland areas.

Jerrabomberra West Nature Reserve (261 hectares) is a lowland native grassland located on the opposite side of the Monaro Highway to the Jerrabomberra East and Bonshaw grasslands forming part of a large complex of native grassland habitat in the Jerrabomberra valley.

Both these reserves, totalling over 600 hectares, form one of the largest areas of Natural Temperate Grassland in the ACT and are home to many threatened species of plants and animals, including the critically endangered Canberra Grassland Earless Dragon, the Striped Legless Lizard, the Pink-tailed Worm-lizard, the Golden Sun Moth and the Perunga Grasshopper. Several threatened or declining bird species, such as the Brown Treecreeper, the Diamond Firetail, White-winged Triller and the Flame Robin live in the woodland areas of the reserves. Jerrabomberra West reserve is also one of just two recorded locations of Medusa Bog-sedge in the ACT, and Jerrabomberra East is home to the critically endangered Ginninderra Peppergrass.

5.3.4 Jerrabomberra Wetlands Management Plan – ACT Government 2010

Jerrabomberra Creek joins Lake Burley Griffin at the Jerrabomberra Wetlands. The wetlands Plan of Management is a detailed document that brings together information about the reserve and specific management actions that inform the annually updated Jerrabomberra Wetlands Operational Plans.

5.3.5 State of the Environment Reporting (ACT and NSW Combined) Specific Recommendations Relevant to Jerrabomberra Creek

State of the Environment Reporting in 2018 / 2019 provide some specific recommendations that are relevant to this Catchment Plan. Categories include climate change, human settlements, air, land, biodiversity, water and fire. More information can be found at https://envcomm.act.gov.au/soe_about-the-report/ for the ACT and <https://www.soe.epa.nsw.gov.au/> for NSW.

6 Jerrabomberra Creek Management Principles and Actions

The Jerrabomberra Creek Catchment Plan is a community-based strategy that will guide people to undertake actions that aim to:

1. Improve habitat connectivity (including riparian vegetation), water quality, soil health, biodiversity and promoting sustainability.
2. Protect and enhance habitat for endangered and threatened wildlife.
3. Recognise that humans are an integral part of the landscape and the need to manage for multiple outcomes, with sustainability as a core focus.

Management principles and associated actions have been developed with reference to a comprehensive literature review, and liaison with key people, to ensure that recommendations adhere to legislative and planning instruments, as well as aligning with the broader guiding principles set out in various plans.

For some areas of the catchment, in particular the government managed land in the ACT, there was sufficient background information and resources to develop an implementation plan that outlines specific on-ground actions. ACT Parks and Conservation Service (PCS) have an allocated budget available to carry out works in the Jerrabomberra Grasslands and Jerrabomberra Wetlands. For other areas around the urban parts of Canberra, investment in significant works has already been made through the Healthy Waterways project to improve water quality in the Jerrabomberra Creek. For areas in NSW, funding is more sporadic and relies upon community groups or individuals obtaining grants to supplement Council funded works on public land.

For the purposes of planning, Jerrabomberra creek has been divided into nine management units (sections) as shown on Map 3. These are based on topography and land use. Section 7 of this document details actions to be implemented in each of these sections. However, there are some general principles and actions that apply to the entire catchment as follows.

6.1 Stakeholder Engagement

Stakeholder engagement is strong in the Jerrabomberra Creek Catchment and built on 20 years of collaborative projects (a list of stakeholders can be found in Section 4). This is significant, as the Jerrabomberra Creek Catchment spans multijurisdictional areas within a complex planning environment, so having people ready and willing to continue caring for the Catchment is a valuable asset. It also strengthens the ability of partners to attract funding and shows that the community can work together to achieve multiple outcomes.

6.2 Cultural Land Management

Cultural partnerships are critical in land management, and we know that working side by side with Indigenous people enables the sharing of knowledge and the development of trusted relationships. Within the Jerrabomberra Creek Catchment there are important cultural links, including a history of Indigenous pathways, along with cultural sites, scattered throughout the Jerrabomberra Valley, and its hills and peaks (MCG 2015).

The Jerrabomberra Creek Catchment Plan prioritises Indigenous partnerships with the following strategies:

- Establish a River Ranger Program, which was suggested as part of the most recent State of the Environment Report (2019) and allocates funding for individuals and groups to ‘work alongside Ngunnawal Traditional Custodians to measure health, facilitate the design of strategies which would work to heal Country through cultural understanding of water resources and their management’. Jerrabomberra Creek could be a flagship program for this initiative and expanded to include planning and implementation of activities at the broader catchment level.
- Further use of Wandiyali Sanctuary which is an important cultural area and is managed by passionate landholders who are keen to explore traditional land management, including fire management. The landholders work with a number of Indigenous groups already. The site lends itself to larger learning forums as well as on-ground action.
- Support the Jerrabomberra Wetlands Indigenous Programs that engages Indigenous detainees (pre and post release) from Alexander Maconachie Centre and their families, people with community service orders, and

people at risk, in a connection to country program and social wrap-around services. This program could be expanded to include sites outside the wetlands in both the ACT and NSW.

- Develop the Aboriginal Fire Management Framework and work with the newly appointed Aboriginal fire manager at PCS. Songlines, cultural stories, intergenerational transfer of cultural knowledge, protecting the ‘spirit’ of Country, and promoting community health and wellbeing are woven into the methodology of a cultural burn (Commissioner for the Environment 2019). Areas such as the Jerrabomberra grasslands and Wandiyali Sanctuary lend themselves to traditional fire management programs and provide a good opportunity to engage with and share Indigenous knowledge.
- Expand Indigenous engagement to support local businesses that operate in and around the Canberra region and provide tours, bush tucker, medicines, tools, basket weaving, art, health, traditional land management consultation, and sales of products and artwork. These groups work with government and the broader community to also provide social justice, employment, and reconciliation activities that acknowledge past struggles and trauma, but focus on working together to create shared futures.

6.3 Volunteering

Environmental Volunteers who work in the Jerrabomberra Creek Catchment have a detailed knowledge of the environment within which they work. These people contribute their knowledge, time and physical labour. There are several formalised local level volunteer groups in the Jerrabomberra Creek Catchment including Royalla Landcare in the headwaters, Fernleigh Park Landcare, Queanbeyan Landcare, the Narrabundah Wetlands Group and the Friends of Jerrabomberra Wetlands where the creek terminates. There are also a number of other volunteer groups that take part in activities at various locations within the catchment such as Waterwatch, Frogwatch, ACT Young Rangers program, and bird monitoring. The Wandiyali Sanctuary and the Jerrabomberra Grasslands also have volunteers planting native vegetation, arranging woody debris, undertaking weed control and monitoring biodiversity through various field days and other activities.

6.4 Council-managed Natural Areas

Queanbeyan Palerang Council is responsible for managing Council land within the catchment, including the following:

- *Natural areas*, such as Banyalla Close and Waterfall Drive, both in the suburb of Jerrabomberra, where the aim is to:
 - conserve biodiversity and maintain ecosystem function as a natural area.
 - maintain the land, or that feature of the habitat, in its natural state and setting; provide for the restoration and regeneration of the land.
 - provide for community use of and access to the land in such a manner as will minimise and mitigate any disturbance caused by human intrusion.
 - assist in and facilitate the implementation of any provisions restricting the use and management of the land that are set out in a recovery plan or threat abatement plans.
- *Park areas* where the aims are to encourage, promote and facilitate recreational, cultural, social and educational pastimes and activities; provide for passive recreational activities or pastimes and for the casual playing of games; and improve the land in such a way as to promote and facilitate its use.
- *Watercourses*, such as Old Cooma Road and Thoroughbred Drive - both in the suburb of Royalla, with a focus on the instream environment, particularly water quality and water flows. Additional aims are to manage the watercourse to protect the riparian environment including vegetation, wildlife habitat and bank stability. Restoring degraded watercourses and educating the community about these areas is also a priority.
- Lake Jerrabomberra, a human-made stormwater retention basin, situated on the eastern side of Jerrabomberra Creek at Jerrabomberra Estate. Lake Jerrabomberra is classified as ‘Operation Land’ under the QLEP 1998 for the purposes of stormwater drainage, and as such, is not covered by the Jerrabomberra Plan of Management (which relates only to community land). There is an operational Draft Plan of Management which specifically addresses management and maintenance of the lake.

6.5 Specific Land Management Issues

The following issues have been identified as areas to focus on in order to improve the values of the Jerrabomberra Creek (or to prevent further degradation). It should be noted that a number of projects to address these issues have already been undertaken in various areas by different groups over many years. The details of these are expanded on in Section 7.

6.5.1 Riparian Areas

Riparian areas are important focus areas for protection, enhancement and rehabilitation as they buffer waterways from catchment activities, improve water quality and promote connectivity of habitat through the landscape. The Jerrabomberra Creek Catchment is highly modified and Wasson and Starr (1999), stated that rehabilitation needed to focus on:

- revegetating riparian areas,
- preventing livestock access to creek channels through fencing,
- providing alternative livestock watering points,
- encouraging sustainable grazing practises.

These rehabilitation activities, they argued, are the most appropriate actions to stabilise the creek's channels, stream banks and gullies, and prevent excessive mobilisation of sediment, improving water quality.

Another problem for the Jerrabomberra Creek Catchment is a decline in connectivity between waterways and the adjoining land (floodplains and wetlands). This is primarily due to historic clearing of vegetation for agriculture and urban development (in particular loss of native groundcover). Low river flow conditions, climate change impacts (higher temperatures, increased drought and storm events), and fire also impact on riparian vegetation, resulting in a further loss of habitat and increased disconnection.

6.5.2 Willows and Other Riparian Woody Weeds

There are a number of willow species in the Jerrabomberra Creek Catchment, mostly in areas where grazing has been abolished, and particularly in areas close to urban settlements. Species include Crack Willow (*Salix fragilis*), Golden Upright Willow (*Salix vitellina pendula*), Basket Willow (*Salix viminalis*), and Weeping Willow (*Salix babylonica*), however, there are likely to be others along with hybrids. Seeding willows such as Black Willow (*Salix nigra*) and Tortured Willow (*Salix matsudana* 'Tortuosa') do not appear at this stage to have established. In some parts of the Jerrabomberra Creek Catchment there are dense infestations of willows and their numbers are increasing. The lower the infestation, and the higher the 'naturalness' of the waterway reach, the higher the priority for control. This is because stopping small infestations early is far more efficient than leaving them to spread and become dense, impenetrable willow complexes. Some work has been implemented to control problem willows in several areas along the creek and this needs to continue along with follow up activities to ensure that the outcomes of past investment is effective long term.

6.5.3 Vegetation Connectivity

It is well recognised that the replanting of native species in cleared riparian zones and the removal of weed species would greatly improve aquatic health and the amenity of aquatic ecosystems (SoE 2019). For grasslands and urban areas, care needs to be taken to ensure species choice, placement and potential impacts are considered (for example, stormwater management). In the Molonglo Catchment Strategy (2015), the overarching goal for this landscape over the next fifteen years to 2025 is to increase connectivity for woodland and grassland species; with a secondary goal of improving riparian vegetation. This will build on past native vegetation planting undertaken by Little Burra, Royalla, Fernleigh Park and Queanbeyan Landcare members in NSW, and Parkcare and PCS in the ACT (MCG 2015).

A much larger ten-year project has been proposed by the Molonglo Conservation Group to boost connectivity in the Jerrabomberra Valley. If resourced, this project would focus on managing the landscape for threatened woodland birds and other endangered species, as well as look at options for the best woodland/grassland spatial matrix to promote these species and reinstate species that are missing. According to Molonglo Conservation Group (2015) interest in the past has been expressed by council, South East Local Land Services, NSW Office of Environment and Heritage, Buru Ngunawal Aboriginal Corporation, Thunderstone Aboriginal Cultural and Land

Management Services, Kosciuszko to Coast, and Queanbeyan Landcare. There have also been discussions with the ACT Environment and Planning Directorate on the possibility of extending the project, with separate funding, beyond the ACT side of the border; this is progressing slowly.

Initiatives with multiple partners, including individual landholders, and a focus on practical actions will be necessary to achieve landscape scale outcomes such as these.

6.5.4 Biosecurity

Biosecurity relates to fauna, flora and aquatic species and is managed through a range of legal, policy, operational and personnel collaborations at various levels of government (Commissioner for the Environment 2019). Assessing management effectiveness can be challenging because of the need for coordinated action across entire landscapes of various tenures and different interest levels of landholders. There are various documents and tools available on all aspects of biosecurity for NSW at:

<https://www.dpi.nsw.gov.au/biosecurity/managing-biosecurity>

and for the ACT at:

https://www.environment.act.gov.au/_data/assets/pdf_file/0007/902293/ACT-Biosecurity-Strategy-2016-2026.pdf

In NSW, weed management is coordinated through Local Land Services offices and local Councils, and in the ACT by the ACT Government. Depending on the scale of a weed infestation, there are different response strategies based on risk to natural assets or productivity. As an area occupied by weeds increases, the strategy changes from one of direct control to one of protecting important natural assets or clean areas. This recognises that the economic return of control decreases with the increased infestation. It also recognises that some weeds are well established, and the prospect of complete eradication is extremely unlikely. In the Jerrabomberra Creek Catchment, there are some significant patches of African Love Grass that have become widespread and impossible to eradicate at the landscape scale, leaving containment and prevention of further spread as the only feasible management approach.

Feral pests include rabbits, foxes, deer, pigs, wild dogs, goats, mice and pest birds. The management of pest animals in NSW is similarly administered under the *Biosecurity Act 2015* (NSW) (the Act), with a range of new, flexible regulatory tools that came into effect in 2018. The Act provides a range of tools and powers that may be implemented for new pests or where stronger controls are needed. While the legislation allows for legal action to be imposed on land managers who do not manage pests properly, or who breach pest management legislation, there is widespread recognition that providing support, advice and education to land managers is the preferred approach to ensure compliance (NSW DPI 2019). In NSW pest management is administered through Local Land Services. The ACT adopts similar strategy to NSW, although there is a higher proportion of government-managed land in the ACT, where control programs are implemented directly.

6.5.5 Erosion Control and Structural Works

The vast majority of erosion can be controlled by managing vegetation (particularly groundcover), regardless of whether it is sheet erosion, streambank erosion or gully erosion. Any structural works that are required, such as rock flumes, water diversion banks and/or dams, need to be undertaken with the aim of stabilising soil enough to establish vegetation.

Large scale structural works need to be carried out by operators who are experienced in riparian rehabilitation and who understand the soils and processes that they are addressing. Organisations such as NSW Soil Conservation Services provide services that specialise in landscape remediation, and although expertise in this area is scarce, there are engineering companies that do undertake these types of works.

For smaller scale issues, there are works (also referred to as 'soft engineering') that can be employed essentially 'by hand' or small-scale equipment to stabilise soil; this is usually relevant to small 'nick points' of less than 1.5 metres or small areas of instability in otherwise stable waterways. 'Mulching' of bare areas using various sized woody debris can also help to build organic matter and help vegetation to establish.

As the appropriate action to address erosion, and the cause of erosion, varies (e.g. much of the erosion in the upper parts of the catchment are related to salinity) it is important that professional advice is sought from

authorities such as Local Land Services, Soil Conservation Services, the ACT Government and Landcare practitioners that understand erosion processes and appropriate control techniques. It should also be noted that often advice will vary slightly. A good rule of thumb is to take a conservative approach and always look to the solution that causes the least disturbance, alongside a risk assessment and cost benefit.

6.6 Incentives Programs for Private Landholders and Community Groups

Incentives programs encourage landholders to personally invest their time and energy into the works to create a sense of ownership and share the project costs. The exception to this is in the case of willow control and erosion mitigation works where an external contractor is often required, due to the need for specialist advice or risk associated with works. In the Jerrabomberra Creek Catchment incentives have been provided to landholders via a 'toolbox' of options that may include:

- Fencing Materials: \$5000-\$7000/km
- Alternative livestock water: up to \$5000/project
- Tubestock: \$2.50 each
- Stakes and Cartons: \$1.50 / cartons - \$3.50 / corflute
- Direct Seeding: \$550/km
- Small scare erosion control: \$5000 - \$10000 per structure
- Willow and woody weed control: variable depending on the context and level of infestation, in addition, the contractor is usually paid direct by the project proponent and can be many tens of thousands of dollars. Maintenance is the responsibility of the landholder, although for willow control it is best practise to factor in at least two follow up control activities over the first five years. Experience has shown that a number of willow control projects have fully regrown (often in less than ten years), and don't take long to become too big for landholders to tackle; Willows in particular grow very quickly when conditions are favourable.
- Other weeds: are usually the responsibility of the landholder unless it is a government or community landscape initiative.
- Installation labour, maintenance and monitoring is usually the responsibility of the landholder, to ensure a shared investment and ownership by landholders.

Other ways of engaging landholders may also be through stewardship agreements and / or management payments. The methodology used in developing incentives programs is often dependant on the proponent and funding body.

In NSW there are existing schemes where individual landholders can have their habitat assessed and receive different levels of funding assistance to manage it. For example, the Land for Wildlife Program offers \$2000 / year for three years to landholders to protect and improve wildlife habitat and is not required to be listed on their title. Another option is a Voluntary Conservation Agreement (VCA) which requires land to be protected in perpetuity to care for and maintain designated ecological communities and species which attracts a much higher annual payment. There are also a number of carbon sequestration programs where carbon farming can provide an income for larger revegetation projects.

More information can be found about these programs at:

- Land for Wildlife: <https://www.environment.nsw.gov.au/cpp/landforwildlife.htm>
- Biodiversity Conservation Trust: <https://www.bct.nsw.gov.au/>
- Carbon Farming: <http://www.cleanenergyregulator.gov.au/ERF/About-the-Emissions-Reduction-Fund>

6.7 Monitoring, Evaluation and Mapping

Monitoring, evaluation and mapping of activities is essential for determining catchment health and whether activities are having a positive or negative impact. For Jerrabomberra Creek Catchment there is no single consolidated monitoring program, but aspects of catchment health are tracked through different citizen science interest groups including:

- *Waterwatch*: there are four water quality monitoring sites from Royalla to Jerrabomberra Wetlands. Waterwatch monitoring and reporting (through the Catchment Health Indicator Program - CHIP) is comprehensive and the data collected helps to inform management actions.

- *Frogwatch*: there are numerous Frogwatch sites in the ACT section of the Jerrabomberra Creek Catchment, including eight sites in the Jerrabomberra Wetlands. There are no active sites in the NSW section of the catchment on the Frogwatch database, although there are previously monitored sites at Environa and Royalla. It would be beneficial to set up four or five Frogwatch sites to provide opportunities for community engagement while enabling the collection of valuable information.
- *Jerrabomberra Grasslands*: there is an extensive research program into the different interventions and responses in relation to management of grasslands and threatened species. The creek is not yet monitored as part of this project. There is some useful baseline information in HGL mapping undertaken in by Wooldridge (2015) which has been included in the action plan for this section of creek.
- *Wandiyali Sanctuary Monitoring Program*: there are currently photo monitoring and bird surveys being done; the program operators have expressed an interest in developing a more comprehensive plan in relation to the restoration works being carried out.
- *Stringybark Reserve Vegwatch and bird monitoring* undertaken by QPRC (in partnership with MCG).
- There are likely to be other examples which can be incorporated into the Plan in response to stakeholder input.

The use of citizen science (whereby interested volunteers carry out monitoring, experimental work and data collection) provides a good opportunity for the engagement of volunteers (see Section 6.4). The following community-appropriate tools, listed below, are ideal for use under the plan and, with some basic training (and in addition to photo-monitoring), would be useful for undertaking initial assessments and for monitoring changes in condition.

- Vegwatch (for the monitoring of vegetation and habitat change) administered by Molonglo Catchment Group <http://www.act-vegwatch.org.au/>
- Rapid Appraisal of Riparian Condition (RARC) administered by Australian River Restoration Centre and used by Waterwatch <https://arrc.com.au/product/rivers-of-carbon-rapid-appraisal-of-riparian-condition/>
- Ephemeral Stream Assessment (soil stability) as used by Australian River Restoration Centre (with permission), according to the works of Machiori, Tongway and Loch and CSIRO Sustainable Ecosystems (2003).'

In addition to basic monitoring, other activities such as bird surveys, fauna surveys and keeping records of project progress are essential. A monitoring gap in the Jerrabomberra Creek Catchment is soil health, with erosion, salinity, structure decline, reductions in organic content and the improvement or decline in native vegetation and biodiversity all indicators that could be assessed. There is some work by Wasson and Starr in 1999 that provides a good baseline, as does the HGL mapping for Royalla and Symonston landscapes commissioned by the ACT Government in 2015 (Woodridge).

There are also discrepancies between the way in which data is mapped in the ACT and in NSW, particularly as it relates to the mapping of vegetation communities and threatened species. Consolidating mapping across the Jerrabomberra Creek Catchment is a priority for future investment and something that will be integrated as part of the new Plan. It is hoped that eventually there will be a 'State of the Jerra Catchment' report that can be used by both ACT and NSW Governments for State of the Environment reporting and catchment planning.

7 Implementation Plan

The Jerrabomberra Creek Catchment is divided into nine sections, from its headwaters in Royalla to Lake Burley Griffin in Fyshwick. Refer to Map 3.

Each section is set out with a description and overview, and a specific set of practical recommended actions that aim to protect and manage biodiversity and natural assets within a framework of landscape function and socioeconomics.

Section 1 Headwaters

Section 2 Headwaters to Pingarra

Section 3 Pingarra to Old Cooma Road

Section 4 Old Cooma Road to Church Creek

Section 5 Church Creek to Fernleigh Park

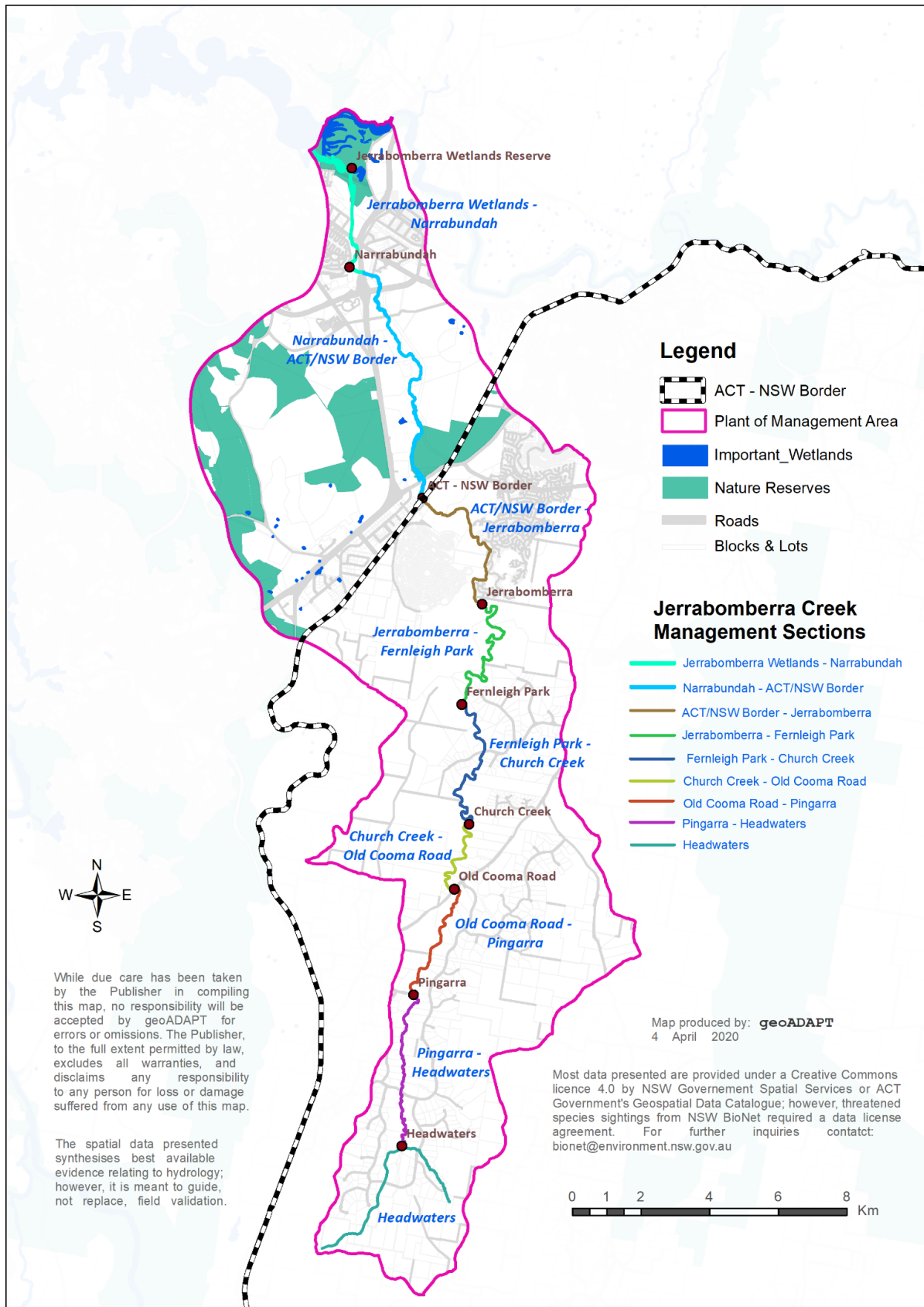
Section 6 Fernleigh Park to Jerrabomberra

Section 7 Jerrabomberra to the ACT Border

Section 8 ACT Border to Narrabundah

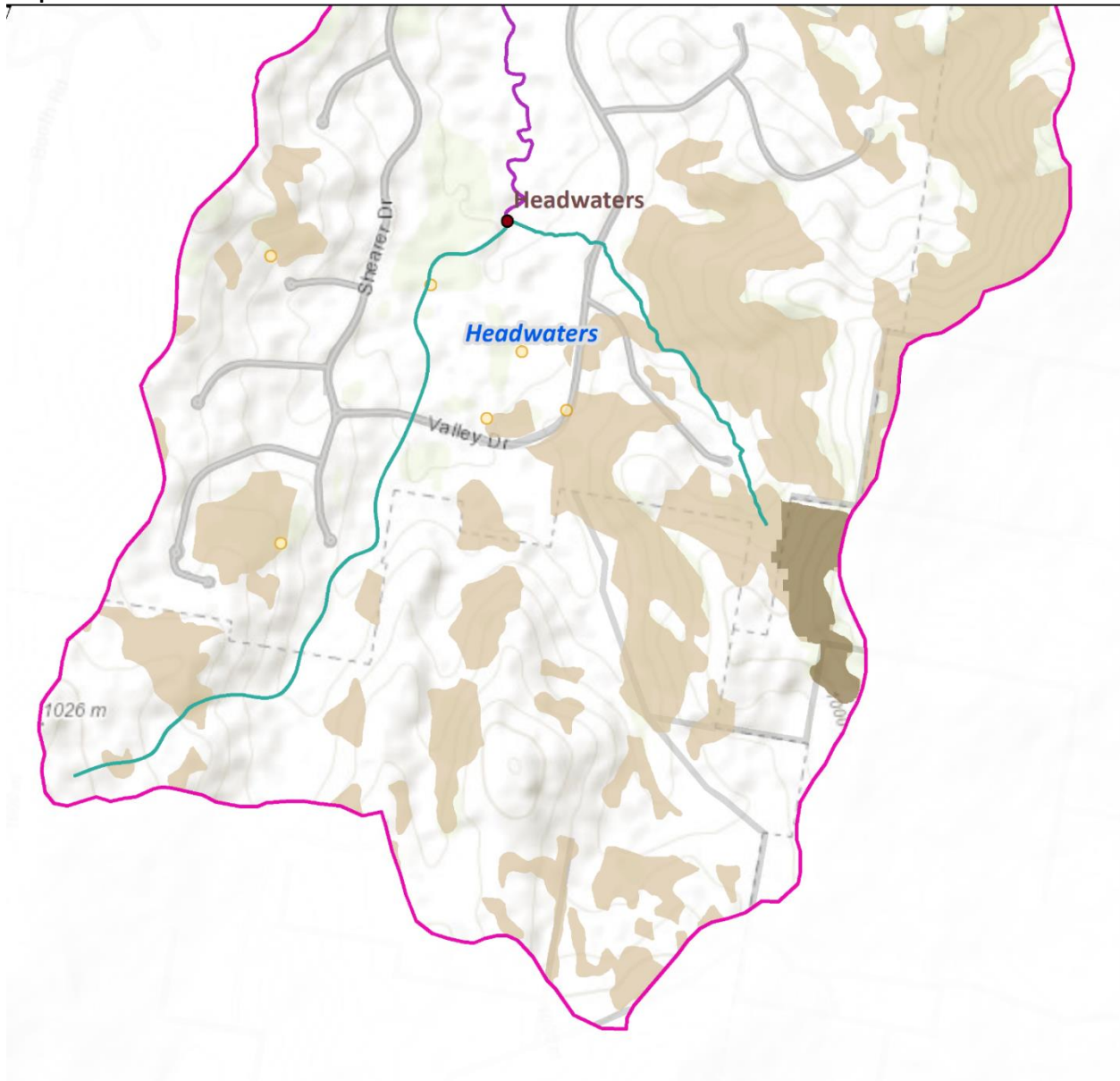
Section 9 Narrabundah to (and including) Jerrabomberra Wetlands

Map 3 Jerrabomberra Creek Management Plan Sections



7.1 Section 1 Headwaters

Map 4 Jerrabomberra Creek Headwaters



Jerrabomberra Creek Management Sections

- Pingarra - Headwaters
- Headwaters

- ACT - NSW Border
- Planning Boundary
- Important_Wetlands
- Nature Reserves

- Threatened Species
- Grasslands
- Woodlands
- Dry Sclerophyll
- Blocks & Lots
- Roads

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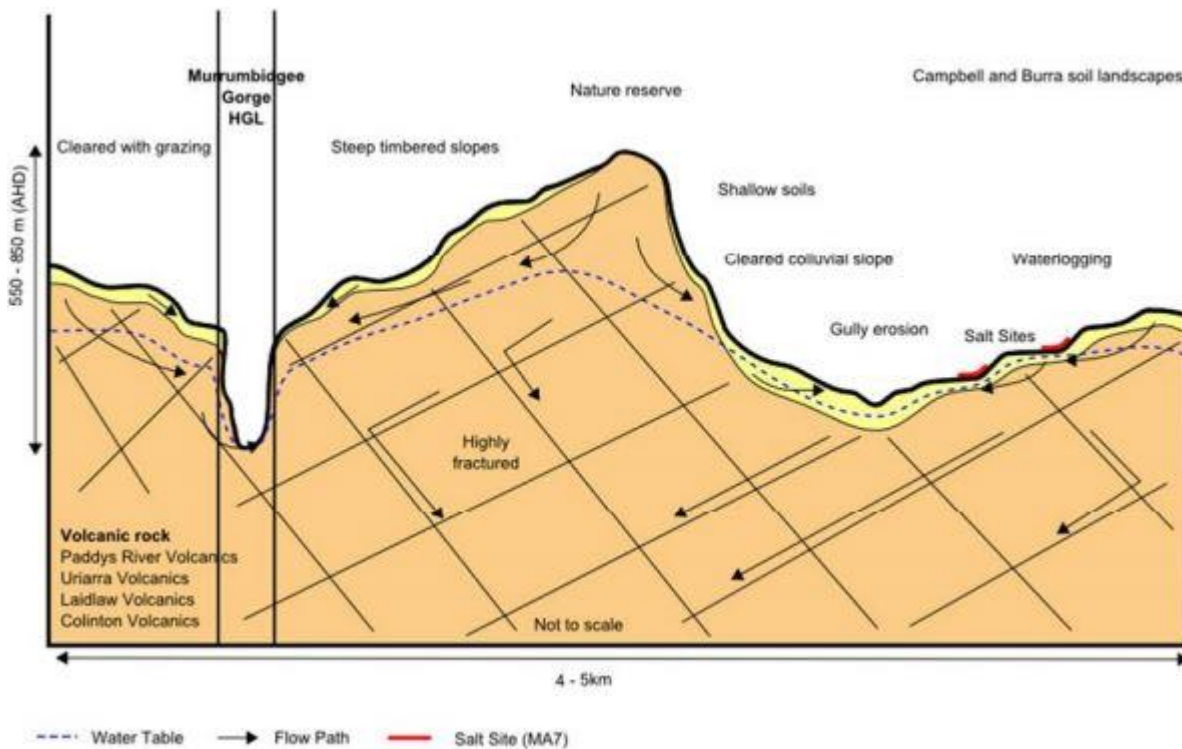
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7.1.1 Description

The headwaters of Jerrabomberra Creek Catchment flow through the southern parts of Royalla and split into two major waterways with numerous smaller tributaries further south. The surrounding landscape consists of moderate to steep slopes, which are well-wooded, dropping down to a flat valley floor through which Jerrabomberra Creek flows. The tributaries that feed the creek are best characterised as a complex network of drainage lines, with shallow soils where bedrock is exposed. Much of this area retains its original vegetation, although in the upper parts of the catchment, where groundcover is more fragile on sodic soils (and therefore prone to the impacts of hard hoofed grazing animals), there are some areas of significant erosion. There are also a high number of old soil conservation banks and dams, dating back to the 1970s and 1980s, when it was common to address erosion this way at a broader scale. Hydrogeological Landscape (HGL) mapping (Figure 3) carried out for this area deemed it to have a 'moderate' salinity and erosion risk which means that the landscape needs to be managed sensitively to protect fragile soils. The landscape has a legacy of past agricultural clearing and, although land tenure is changing to rural residential and mixed land use which has (overall) resulted in higher levels of groundcover, erosion issues remain. There is little evidence of any historic broadscale cropping although small areas of pasture 'improvement' have occurred to replace native vegetation with exotic pasture species.

Figure 3 shows the conceptual landscape for the Royalla HGL area (adapted from Wooldridge 2015). The headwaters for Jerrabomberra Creek are in the valley to the right of the diagram.



Vegetation in this part of the catchment mostly consists of dry Sclerophyll forest on the steeper slopes, which transitions into fragmented Endangered Ecological Community Box Gum woodland on the mid to lower slopes. The valley floor would have been a mix of grassy woodland, grassland and swampy meadows, however, since European settlement, these have been modified for agriculture and rural residential development by the draining of swamps, clearing of vegetation, erosion and introduction of exotic species. There are still large areas of native pastures remaining and these need to be protected and managed accordingly.

7.1.2 Important Natural Attributes

As mentioned, Box Gum Woodland is an Endangered Ecological Community, which supports a number of threatened species recorded in the area. These are listed in Table 5.

Table 5 Threatened species recorded in the Headwaters of Jerrabomberra Creek (V = Vulnerable P = Protected (NSW))

| Species | Common Name | Listing NSW | Listing Federal |
|-------------------------------|-----------------------------------|-------------|-----------------|
| <i>Pteropus poliocephalus</i> | Grey-headed Flying-fox | V, P | V |
| <i>Melanodryas cucullata</i> | Hooded Robin (south-eastern form) | V, P | |
| <i>Swainsona sericea</i> | Silky Swainson-pea | V | |

(Source: NSW Government Bionet)

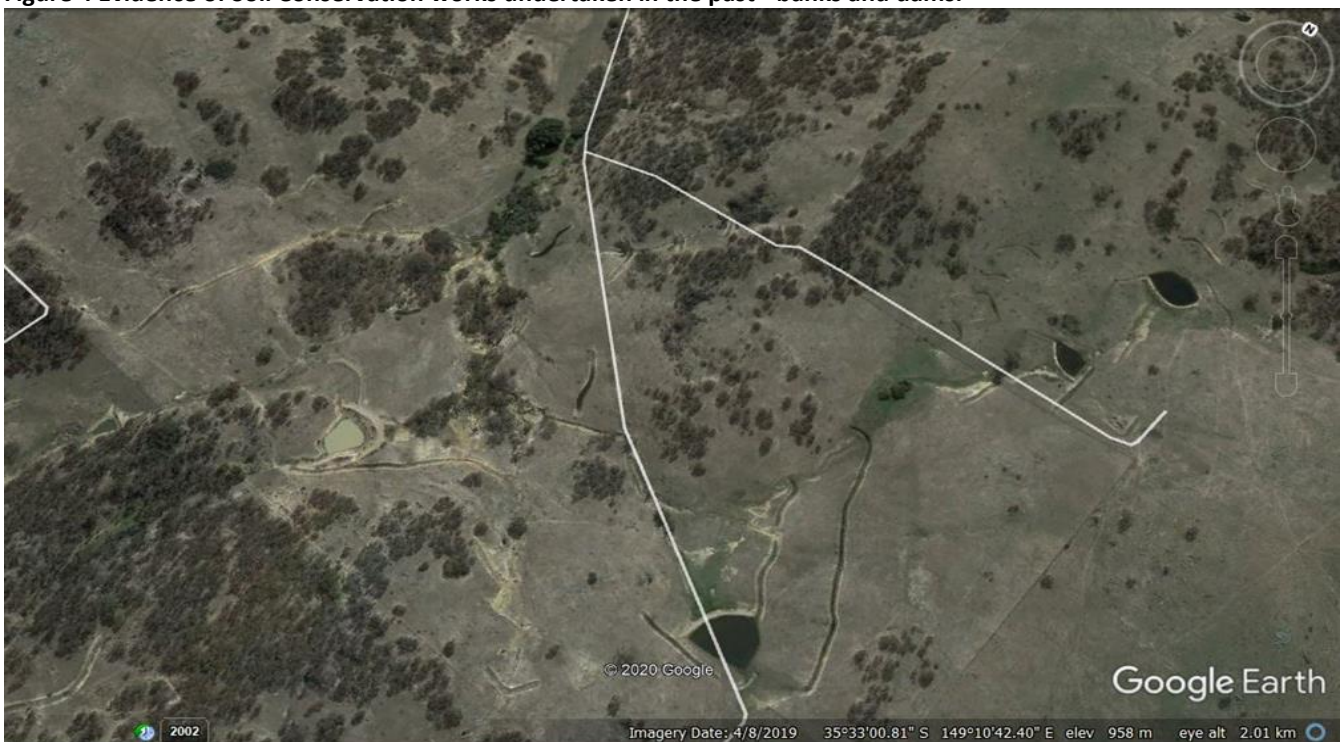
7.1.3 Threats

The main threats to biodiversity and landscape integrity are overgrazing of unstable soils (mass movement, water erosion, soil acidity) and weeds (Serrated Tussock, African Love Grass and woody weeds); there are also many dams constructed for rural residential development along with dozens of bores. These developments have altered the hydrology in the headwaters by reducing flow downstream, and the high number of bores creates a potential risk of groundwater contamination (although the actual occurrence of this is yet to be established). Urban and residential development can also introduce threats to native ecosystems including domestic dogs and cats which impact on wildlife, minimal control of weeds due to a lack of understanding, planting of garden escapees which invade natural areas, overgrazing with horses and other domestic livestock, motorbikes and poorly positioned tracks and trails.

7.1.4 Past and Current Initiatives

This part of the catchment has had a lot of soil conservation works undertaken when the land was used primarily for agricultural grazing; evidence of this is shown in Figure 4. There have also been a variety of funding incentive programs centred around helping private landholders improve habitat for threatened species, such as the Hooded Robin Project (through fencing and revegetation).

Figure 4 Evidence of Soil Conservation works undertaken in the past - banks and dams.



7.1.5 Recommended Actions

| Target Area for Action | Details |
|--|--|
| Vegetation Enhancement | Woodland vegetation is intact and covers large areas in the upper parts of this section providing connectivity for wildlife and native ecosystems. , Enhancement actions such as fencing to protect high quality vegetation, as well as fencing and revegetation to increase connectivity require ongoing investment. |
| Groundcover / Biomass Management | Protection of native remnant vegetation, especially groundcover, is the highest priority for this part of the catchment. Managing stock grazing and movement is essential so that fragile land classes (6, 7 and 8) are protected. This would reduce the amount of broad scale sediment entering drainage lines and ultimately the creek. The heavy grazing of kangaroos and rabbits can also impact on soil stability. Their numbers are usually managed through culling (and rabbit poisoning) on larger properties however, this is more difficult in areas with smaller blocks and a higher density of housing. Pest animal numbers follow boom and bust cycles that are linked to seasonal conditions. Protecting vegetation by using fencing, tall guards of individual plants and/or woody debris can be used to protect groundcover to grow in sensitive areas. |
| Willows and Hawthorn | Willows occur in discreet patches and are a high priority so that they do not continue to spread. Hawthorn is another problematic woody weed along waterways and should also be treated. Once grazing pressure is removed, Hawthorn and willows can very quickly get out of control so managing these weeds need to be built into any plans to remove stock. |
| Weeds and Feral Animals | There are large areas of Serrated Tussock and African Lovegrass in this area and in many cases, this is now a matter of containment rather than control. Other noxious weeds include Blackberry, Briar, St John's Wort, Paterson's Curse and thistles. Feral animals include rabbits, foxes, pigs, deer and wild dogs. There are some local management programs but these need to be further developed with assistance from South East Local Land Services. |
| Hydrological Enhancement / Erosion Control | Water quality downstream relies upon the sensitive management of unstable soils through grazing management (mentioned above) and careful placement of infrastructure such as access tracks (along with removal of those that are causing ongoing erosion). Most of the unstable channels in this part of the catchment are stabilising, however, active head cuts (erosion nick points) are still occurring. There is evidence of significant soil erosion works having been undertaken in the past with mixed success; some of the banks around the erosion gullies are now also eroding, whereas some of the work was successful in reducing the upward progression of head cuts. More work needs to be done and today there is more focus on maintaining groundcover by fencing sensitive areas from livestock and using 'low key' engineering works, such as the simple laying of geofabric and placing rock by hand and/or spreading brush and mulch over bare areas to introduce organic matter. |

Table 6 Recommended Actions for Jerrabomberra Creek Headwaters

7.1.6 Community Engagement and Funding Opportunities

Targeted incentives programs for landholders in this area, along with community education in the form of field days and farm walks have proven to be successful and should be continued to engage more of the community across a larger landscape footprint. Royalla is one example of successful long-term community engagement resulting in significant on ground actions and outcomes. This success is the combination of passionate community members, access to knowledge (people and written resources), on-ground incentives and demonstration of outcomes. One factor making ongoing community action a challenge is the high turn-around times of residents in rural residential areas. To overcome this problem, community engagement and provision of knowledge needs to be continually shared. This area lends itself to ongoing incentives programs led by community and supported by grants and knowledgeable practitioners.

Project Focus Areas

- Implement sustainable grazing management to improve groundcover on unstable areas (including fencing and destocking of erosion areas and promotion of perennial groundcover).
- Investigate the extent of specific erosion hazards and ascertain the need for targeted activities to address these.
- Protect and connect woodland habitat for birds and other wildlife through fencing and revegetation.

Next Steps

- Mapping of past on-ground works projects, vegetation connectivity, threatened species and willow infestations.
- Assessment of specific biosecurity threats (in consultation with South East Local Land Service) and identification of any specific issues (especially pest animals).
- Designing an incentives program offering fencing, native vegetation, alternative livestock water, direct seeding, and structural works for erosion.
- Development of a willow management strategy outlining control priorities, landholder consultation, and estimated cost, funding opportunities and risk, with a view to obtaining funding and engage a contractor (rather than as individual landholder incentives).
- Providing support for maintenance of existing projects (advice and/or resources).
- Setting up photo monitoring points.
- Developing a community engagement strategy to support the above in partnership with South East Local Land Service and Landcare.

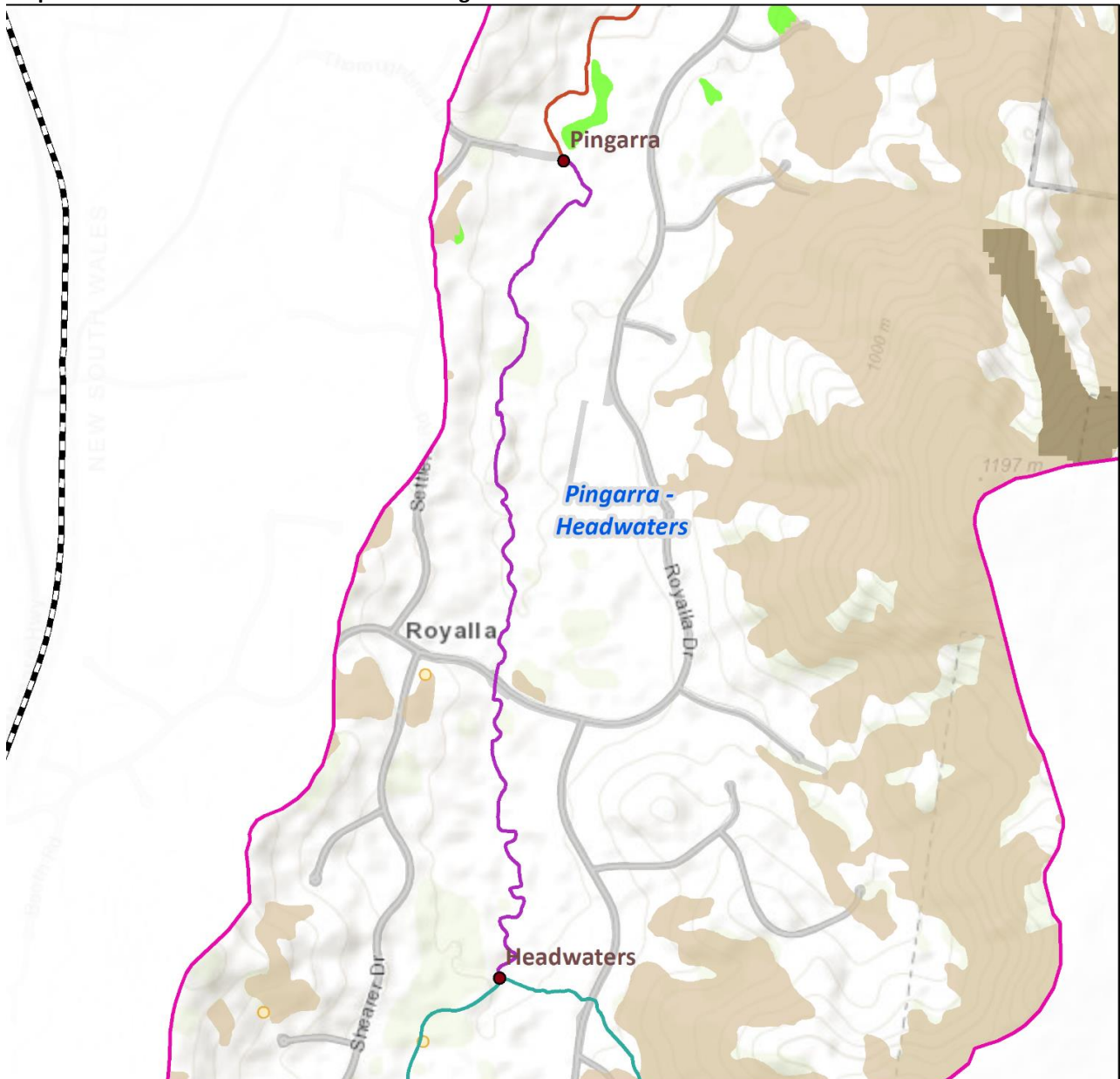
Key Contacts

These are groups who have in the past, or continue to deliver programs and projects in this area:

- Royalla Landcare
- South East Local Land Services
- Molonglo Conservation Group
- SE Local Land Services
- Greening Australia
- Small Farms Network

7.2 Section 2 Headwaters to Pingarra

Map 5 Jerrabomberra Creek Headwaters to Pingarra



Jerrabomberra Creek Management Sections

- Old Cooma Road - Pingarra
- Pingarra - Headwaters
- Headwaters

- ACT - NSW Border
- Planning Boundary
- Important_Wetlands
- Nature Reserves

- Threatened Species
- Grasslands
- Woodlands
- Dry Sclerophyll
- Blocks & Lots
- Roads

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7.2.1 Description

The development of the Royalla Estate and surrounding rural residential blocks, along with its agricultural history and locality as a settlement on the Bombala railway line, has resulted in significant changes to the natural landscape. This area was once swampy meadows and sparse open woodlands, however, clearing and draining wet areas has resulted in the swampy meadows becoming incised eroding streams. Patches of high-quality native vegetation including threatened ecological communities, such as Yellow Box-Red Gum woodland, with native grassy understory remain in the catchment and are protection priorities.

7.2.2 Important Natural Attributes

There is small, but notable, samples of Grasslands and Box-Gum Woodlands of considerable diversity, including Royalla and Burra Travelling Stock Reserves and a railway reserve.

Table 7 Threatened species recorded in the Jerrabomberra Creek Headwaters to Pingarra, (E = Endangered)

| Species | Common Name | Listing NSW | Listing Federal |
|------------------------|------------------|-------------|-----------------|
| <i>Swainsona recta</i> | Small Purple-pea | E | E |

(Source: NSW Government Bionet)

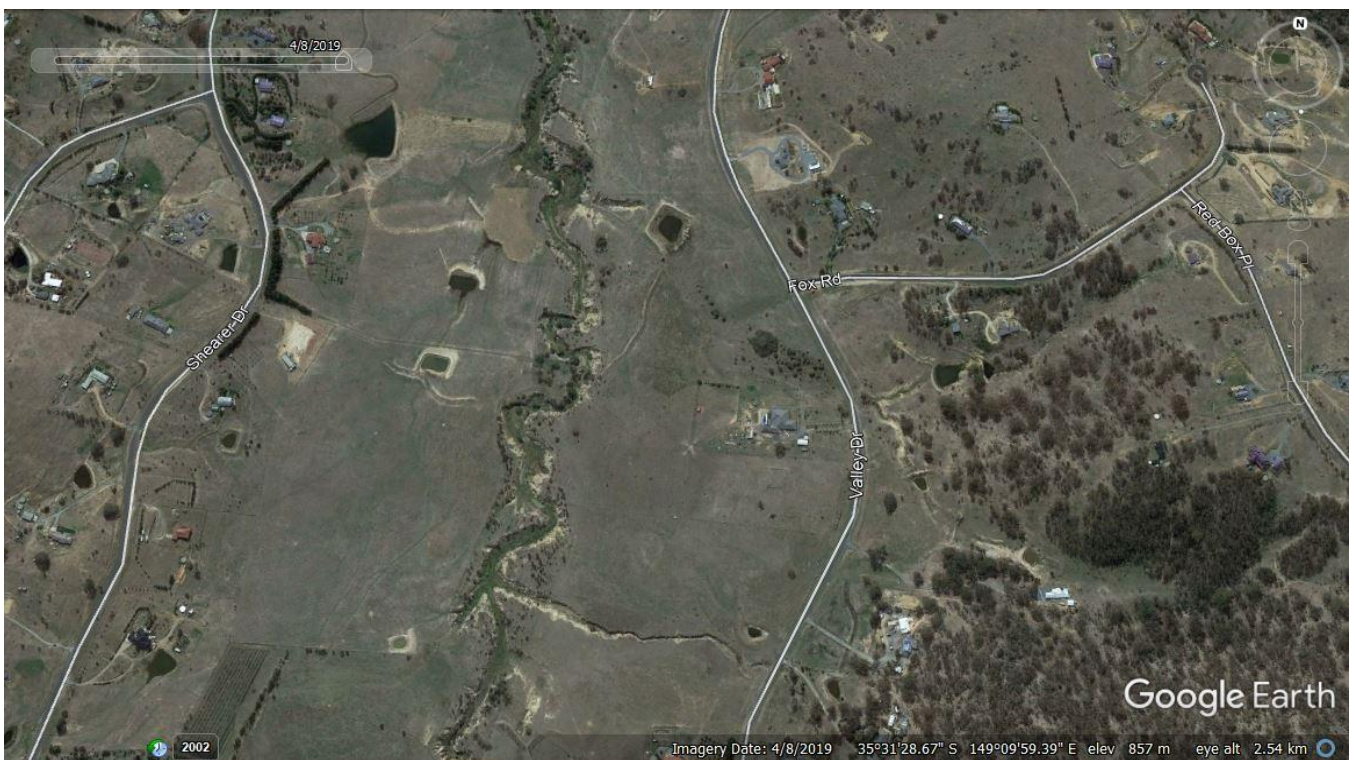
7.2.3 Threats

Most of the Jerrabomberra Creek headwaters are fenced and revegetated, however, there are still a number of tributaries that require attention to address erosion, loss of groundcover and fragmentation of habitat; this will help to improve water quality. Rural residential housing increases the risk of threats from domestic animals, weeds and inappropriately placed tracks and trails; however, it can also attract a higher proportion of conservation minded residents and the opportunity of dedicated community action (which encourages others to act). Many dams have been constructed for rural residential development, along with dozens of bores. This is likely to have altered the hydrology in the headwaters, by reducing flow downstream, with the high number of bores creating a potential risk of groundwater contamination.

7.2.4 Past and Current Projects

In 1999, the Royalla community (broadly) came together to protect, enhance and link habitat for the Hooded Robin, through the Vegetation Investment Project coordinated by Greening Australia. The project was originally targeted towards larger landholders with patches of suitable remnant vegetation of 10 hectares or more (suitable habitat for the Robin). The project was successful in attracting community support with neighbours on smaller blocks joining together to reach the 10 hectares target. The Royalla Landcare Group was formed as a result of community action and has worked in partnership with like-minded groups to revegetate almost the entire length of the Jerrabomberra Creek in the Royalla district, as far down as Mt Campbell; this constitutes almost the entire length of this management section. Other Royalla Landcare projects have planted vegetation to increase habitat for birds such as the Glossy Black Cockatoo and the planting of threatened species. A number of properties are registered with the Land for Wildlife Program. Figures 5 and 6 show 'before and after' satellite imagery of the Jerrabomberra Creek in Royalla from 2002 (before) to 2019 (after), illustrating the large-scale revegetation activities undertaken and the resulting stabilisation of the creek floor.

Figures 5 and 6 'Before and after' works satellite imagery of the Jerrabomberra Creek in Royalla from 2002 (top map) to 2019 (bottom map), illustrating the large-scale revegetation activities undertaken and stabilisation of the creek floor.



7.2.5 Recommended Actions

| Target Area for Action | Details |
|--|--|
| Vegetation Enhancement | Vegetation enhancement should focus on retaining native groundcover through grazing management, protection of remnant native vegetation, replanting of native vegetation for habitat connectivity and replacing lost habitat components for particular wildlife such as the Glossy Black Cockatoo. Target areas should include ones that connect to other Landcare works, or ones that connect to patches of remnant vegetation, to build on habitat and works already undertaken. |
| Groundcover / Biomass Management | Most of the creek and tributaries have already been fenced from livestock. Downstream towards Pingarra the creek remains unfenced and this needs to be addressed so that the creek floor can be stabilised. Once fenced the riparian area will provide a buffer to surrounding land use such as livestock grazing. Tributaries to the creek also need to be targeted. |
| Willows and Riparian Woody Weeds | Willows and riparian woody weeds are not a major issue in this part of the catchment but there are some individual plants starting to establish in the creek channel that need to be removed. There are also some concentrated patches that are continuing to spread, and it is important they do not impact on areas in good condition. Controlling them now will reduce the risk of a major problem in future. |
| Weeds and Feral Animals | There are areas of Serrated Tussock and African Lovegrass that need to be contained. Other noxious weeds include Blackberry, Briar, annual weeds (St John's Wort, Paterson's Curse and thistles). Feral animals mostly include rabbits and foxes, and local and coordinated management programs need to be further developed with assistance from South East Local Land Service. As with all rural residential areas, landholders differ in their ability and efforts to control weeds species, and even in their views about what constitutes a problem. Investment in improving community knowledge is important for areas like Royalla and surrounds. |
| Hydrological Enhancement / Erosion Control | The Jerrabomberra Creek in this area is stabilising. Once a high risk for erosion, the creek itself, and many tributaries, are in the process of repair, and instability is localised. Soil is becoming contained in the landscape and the creek floor is stabilising. This is partly to do with the reduced rainfall but is also due to the creation of a significant riparian buffer along the creek to reduce runoff and withstand catchment activities, such as overgrazing. There is no requirement for major structural works that haven't already been undertaken, however there is scope to improve the habitat complexity in the creek channel by adding strategically placed logs, rock riffles and reeds. |

Table 8 Recommended Actions Jerrabomberra Creek Headwaters to Pingarra

7.2.6 Community Engagement and Funding Opportunities

Recommended actions are to build on and continue to support the Royalla community (Landcare, the Royalla Community Association and individual landholders) so the group can continue its work to care for the creek, its tributaries and the catchment more broadly. Maintenance of areas where works have taken place is important, particularly, willow and weed follow up control and continuing to establish native vegetation. Secure long-term funding would streamline the administration and coordination of activities.

Project Focus Areas

- Fencing and/or revegetation of Jerrabomberra Creek and tributaries where works have not yet been undertaken.
- Connecting patches of remnant vegetation and past Landcare works through revegetation corridors.
- Undertaking maintenance works on past projects including willow and weed control.

Next Steps

- Mapping of past projects, vegetation connectivity, threatened species, willow and weed infestations.
- Working with Royalla Landcare to develop an incentives program offering fencing, native vegetation, direct seeding, and willow control. Small scale erosion control works may also be required in places.
- Development of a willow management strategy outlining control priorities, landholder consultation, and estimated cost, funding opportunities and risk.
- Providing support for maintenance of existing projects (advice and/or resources).
- Setting up photo monitoring points.

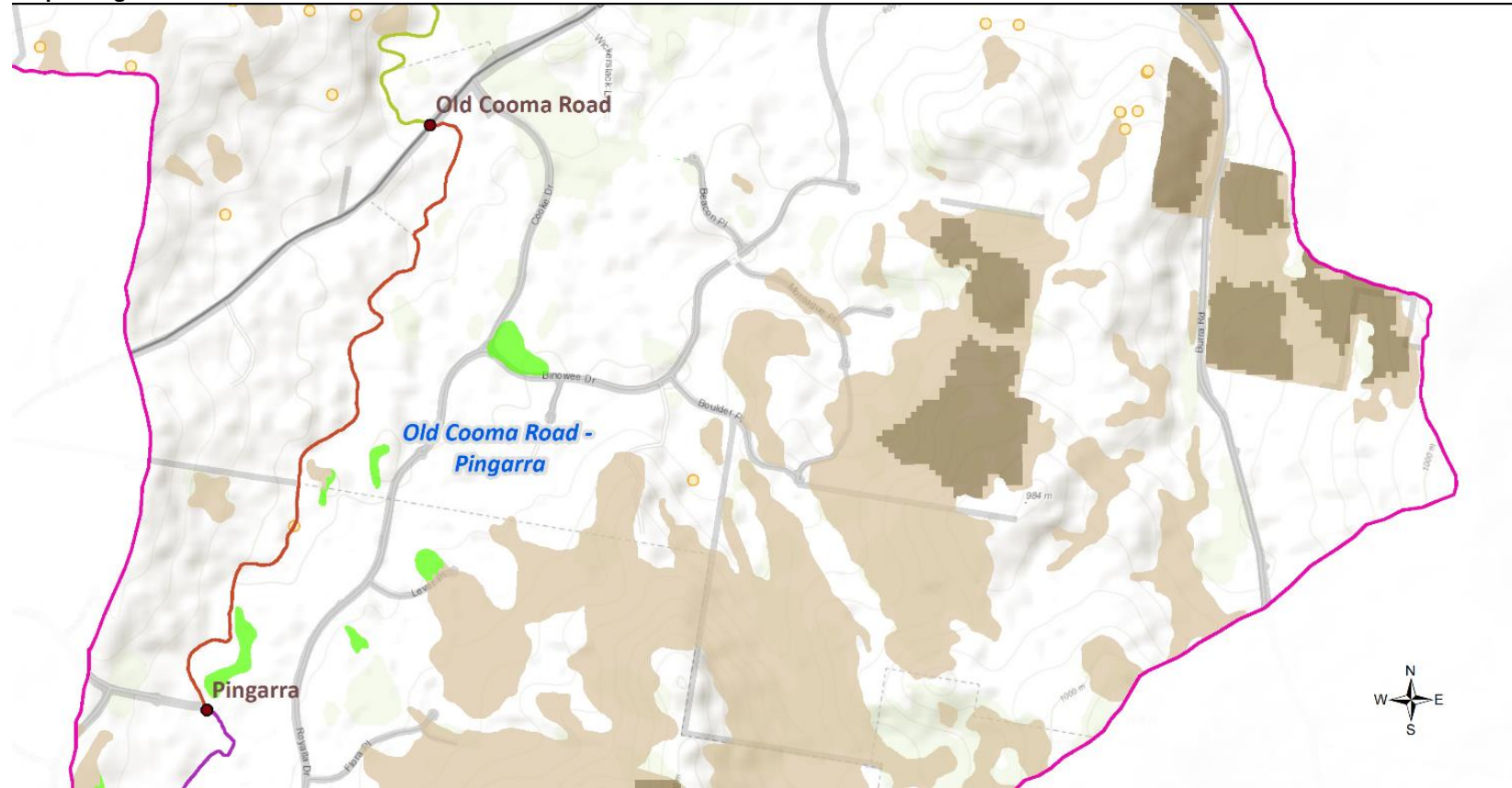
Key Contacts

These are groups that have in the past, or that continue to deliver programs and projects in this area:

- Royalla Landcare
- South East Local Land Services
- Molonglo Conservation Group
- Greening Australia
- Queanbeyan Palerang Council (public lands)
- Small Farms Network

7.3 Section 3 Pingarra to Old Cooma Road

Map 6 Pingarra to Old Cooma Road



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The spatial data presented synthesises best available evidence relating to hydrology; however, it is meant to guide, not replace, field validation.

- ACT - NSW Border
- Planning Boundary
- Important_Wetlands
- Nature Reserves
- Roads
- Blocks & Lots
- Threatened Species
- Grasslands
- Woodlands
- Dry Sclerophyll

Jerrabomberra Creek Management Sections

- Church Creek - Old Cooma Road
- Old Cooma Road - Pingarra
- Pingarra - Headwaters



Map produced by: **geoADAPT**
25 March 2020

7.3.1 Description

This section of the Jerrabomberra Creek Catchment is a mixture of rural residential land, and larger rural lifestyle blocks, some with grazing. This area was previously cattle and sheep grazing land until it was developed early in the 2000s. There is a large swathe of scattered Box Gum Woodland running south to east, patches of dry Sclerophyll forest on the hills and, significantly, some important patches of remnant grasslands in the valley. There is also a dominance of native pasture, with only small areas of pasture 'improvement' with exotic grasses. The Jerrabomberra Creek in this part of the catchment was once a mixture of woodland, grassland and swampy meadows.

7.3.2 Important Natural Attributes

There are some large, mapped areas of Endangered Ecological Community-listed Box Gum woodland and natural temperate grasslands, which are extremely valuable due to their scale and connectivity. Threatened species are listed in Table 9.

Table 9 Threatened species recorded between Pingarra and Old Cooma Road (V = Vulnerable P = Protected [NSW])

| Species | Common Name | Listing NSW | Listing Federal |
|------------------------------|----------------------------|-------------|-----------------|
| <i>Aprasia parapulchella</i> | Pink-tailed Legless Lizard | V,P | V |
| <i>Artamus cyanopterus</i> | Dusky Woodswallow | V,P | |
| <i>Stagonopleura guttata</i> | Diamond Firetail | V,P | |

(Source: NSW Government Bionet)

7.3.3 Threats

Grassland areas are under threat from pasture improvement, overgrazing, and inappropriate planting of native canopy vegetation. Some landholders are continuing to replace native groundcover vegetation with exotic pastures in an attempt to pasture 'improve'. Education is required to raise awareness about the negative consequences of doing this, as groundcover diversity is diminished as well as the resilience of the landscape to withstand the extremes of climate change.

Other threats include weeds such as Serrated Tussock (that have not already dominated an area), and the occasional willow dotted along the creek, which if left unmanaged could become a future threat. The only major patch of willows is where the Jerrabomberra Creek flows under the Old Cooma Road.

7.3.4 Past and Current Projects

Some of the landholders in this part of the catchment have been involved with incentives programs and, as a result, there are native vegetation corridors linking the creek to surrounding vegetation. Most of the Jerrabomberra Creek is fenced, which could have been the result of the original development of the large blocks where they share the creek at their boundary, but this would need to be confirmed. The creek through this section is largely devoid of vegetation although there is a scattering of individual remnant trees. Figure 7 shows satellite imagery of the Pingarra to Old Cooma Road section of the Jerrabomberra Creek Catchment, illustrating the mixture of land use, including areas of pasture improvement, native pastures, treelines, scattered trees and the layout of rural residential development.



Figure 7 shows the mixture of land use with the Jerrabomberra Creek flowing between Cooke Drive and Old Cooma Road. This includes areas of pasture improvement, native pastures, treelines, scattered trees and rural residential development.

7.3.5 Recommended Actions

| Target Area for Action | Details |
|--|--|
| Vegetation Enhancement | Vegetation is scattered across the landscape, with some areas of revegetation, mostly in the form of corridors. Landholders should be encouraged and supported to undertake more revegetation to enhance, and ultimately replace, old growth trees that may be suffering dieback. Areas of native grasslands should be maintained and need to be considered when planning revegetation activities. |
| Groundcover / Biomass Management | Native groundcover needs to be managed appropriately with destocking and/or implementation of sustainable grazing practises to enhance biodiversity. Replacing native groundcover with exotic pasture should be strongly discouraged. |
| Willows and Riparian Woody Weeds | Controlling these is a very high priority as there are very few willows or woody weeds, occurring only in small patches, making control measures cost effective. There is one patch at the Old Cooma Road bridge which should be considered for control. |
| Weeds and Feral Animals | Serrated Tussock is a particular problem on some of the properties in this area, and landholders manage it in different ways. Some landholders do nothing, while others spray it and/or replace it completely with exotic pastures (with varying success depending on the season). Government and organisational support for control would complement other biodiversity enhancement projects to raise awareness and encourage action. Foxes and rabbits remain in high numbers in the area and a regional well-coordinated control program would be beneficial. |
| Hydrological Enhancement / Erosion Control | There is no requirement for any significant hydrological enhancement or soil erosion works as most of this section of the creek and its tributaries is stable. There is some localised bank and sheet erosion from lack of groundcover, but the creek channel is mostly bedrock controlled. Fencing to keep out livestock will address this problem. |

Table 10 Recommended Actions Pingarra to Old Cooma Road

7.3.6 Future Community Engagement and Funding Opportunities

This area was originally agricultural but since 2000 with subdivision and the development of Little Burra and the suburb of Googong, the community has diversified. Although there is evidence of past revegetation projects (some of which were undertaken when the area was predominantly grazing), this is an area that requires community engagement activities to raise awareness and understanding of environmental issues and the incentives available.

Project Focus Areas

- To raise awareness about the importance of native grasslands and native pastures as well as weed and grazing management.
- Strategic revegetation of Jerrabomberra Creek and its tributaries (as a community focus area).
- To undertake revegetation to connect patches of remnant vegetation with fencing used to promote sustainable and native pasture management.

Next Steps

- Mapping of native grasslands and pastures (including assessing the quality of those already mapped through NSW Bionet), along with willow and weed infestations.
- Development of a community awareness raising campaign (community get-togethers, farm walks etc) about grasslands, grazing management, weed management and remnant vegetation connectivity, in conjunction with an incentives program offering fencing, native vegetation, and direct seeding.
- Development of a willow management strategy outlining control priorities, landholder consultation, and estimated cost, funding opportunities and risk.
- Set up photo monitoring points.

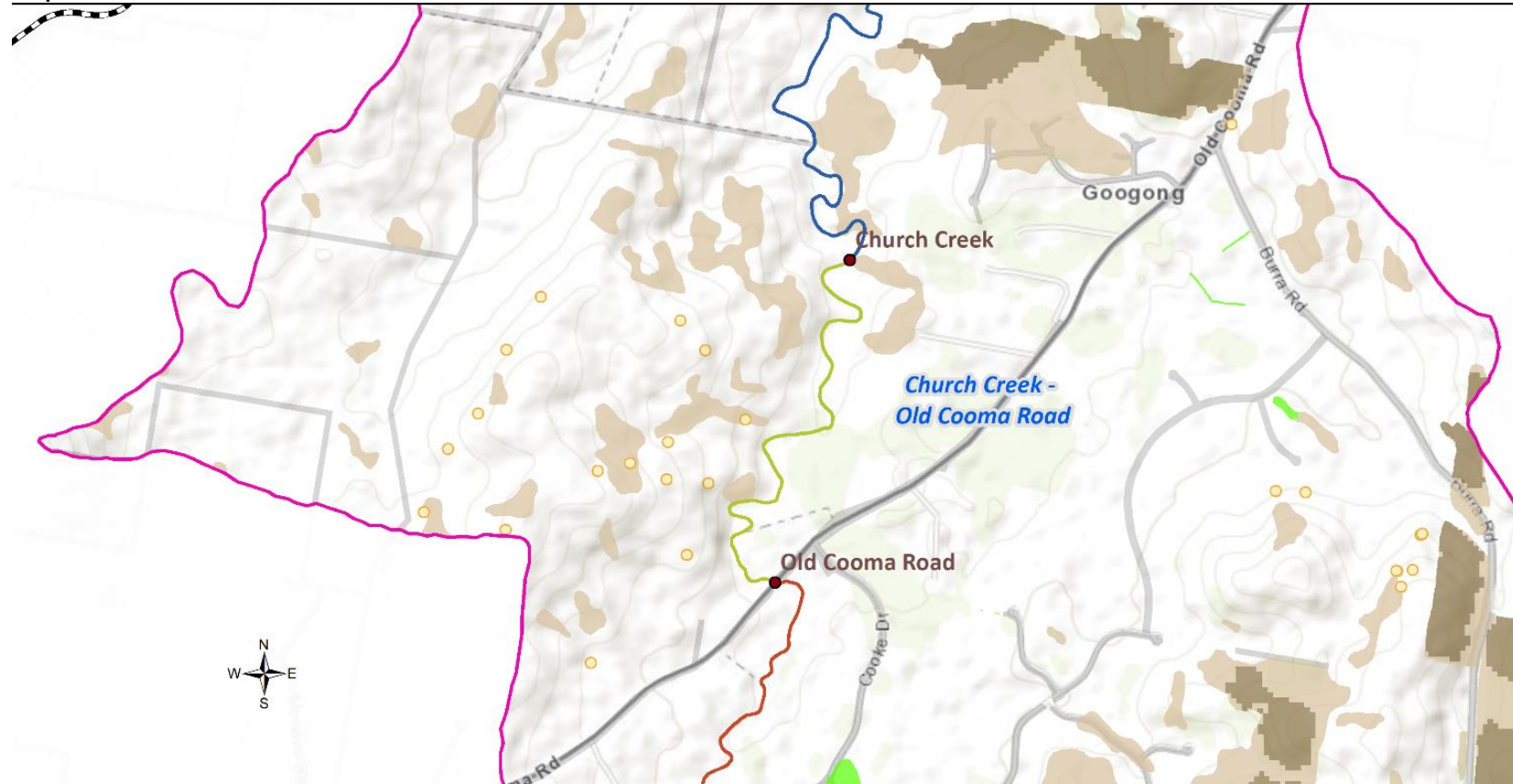
Key Contacts

These are groups who have in the past or continue to deliver programs and projects in this area.

- Molonglo Conservation Group
- Greening Australia
- Royalla Landcare
- Small Farms Network
- South East Local Land Services

7.4 Section 4 Old Cooma Road to Church Creek

Map 7 Old Cooma Road to Church Creek



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The spatial data presented synthesises best available evidence relating to hydrology; however, it is meant to guide, not replace, field validation.

- ACT - NSW Border
- Planning Boundary
- Important Wetlands
- Nature Reserves
- Roads
- Blocks & Lots
- Threatened Species
- Grasslands
- Woodlands
- Dry Sclerophyll

Jerrabomberra Creek Management Sections

- Four Mile Creek - Church Creek
- Church Creek - Old Cooma Road
- Old Cooma Road - Pingarra



Map produced by: **geoADAPT**
25 March 2020

7.4.1 Description

This is a relatively short section of creek which is bound by rural residential development upstream, downstream, and to the east. It differs to other parts of the creek, as the topography becomes steeper and the area west of the creek remains undeveloped, with one of the last large landholdings in the area. The Jerrabomberra Creek system changes from a flat valley floor with a wide floodplain, to a sinuous bedrock-dominated channel with steeper banks and associated slopes. This provides complexity within the channel and there are a variety of pools and riffles. Some of the sediment eroded from upstream, and from steep slopes, has deposited in flatter parts of this section of creek, filling up pools and forming small beaches on the inside of some of the bends. Vegetation is scattered, however previously cleared woodland is regenerating in the less accessible areas where the impacts of grazing are reduced. Figure 8 illustrates this section of creek and the associated catchment area.



Figure 8 Jerrabomberra Creek changes to a sinuous bedrock-dominated channel with steeper banks and associated slopes through this section.

7.4.2 Important Natural Attributes

This area has high quality Endangered Ecological Community-listed Box Gum woodlands with native pastures and is a hotspot of threatened species, which are listed in Table 11.

Table 11 Threatened species recorded between Old Cooma Road and Church Creek (V = Vulnerable P = Protected (NSW))

| Species | Common Name | Listing NSW | Listing Federal |
|---------------------------------|----------------------------|-------------|-----------------|
| <i>Aprasia parapulchella</i> | Pink-tailed Legless Lizard | V,P | V |
| <i>Miniopterus schreibersii</i> | Large Bent-winged Bat | V,P | |
| <i>Artamus cyanopterus</i> | Dusky Woodswallow | V,P | |
| <i>Petroica boodang</i> | Scarlet Robin | V,P | |
| <i>Stagonopleura guttata</i> | Diamond Firetail | V,P | |
| <i>Swainsona sericea</i> | Silky Swainson-pea | V | |

(Source: NSW Government Bionet)

7.4.3 Threats

Threats to biodiversity include overgrazing, large patches of Serrated Tussock, some willows (although the infestation is very low) and other exotic vegetation. Most of this section of the creek remains unfenced from

livestock on the western side (however it is virtually all fenced on the eastern side). Unrestricted livestock access, in combination with the steep slopes and livestock tracking, means that hillslope soil has washed into the creek, and this, combined with sediment from upstream erosion, has caused many of the pools to fill with sandy soil. Unrestricted grazing has also prevented the establishment of native groundcover further reducing the Creek's biodiversity and its resilience to catchment pressures. The retention of native Box Gum woodland is enabling the survival of threatened species; as well as the native understory and the inaccessibility of terrain reducing the impacts of agriculture. On the eastern side, the landscape has been modified by rural residential development including the installation of a number of dams, one of them very large and directly adjacent to the creek, possibly old soil conservation works. There is evidence of other soil conservation projects in the immediate area (mostly banks and dams) demonstrating previous attempts to reduce these threats.

7.4.4 Past and Current Projects

Apart from revegetation works on a couple of properties, this area doesn't appear to have been the focus of any significant conservation works.

7.4.5 Recommended Actions

| Target Area for Action | Details |
|--|---|
| Vegetation Enhancement | Vegetation should be protected and enhanced to maintain habitat for threatened species. Native vegetation will regenerate as there is a good seed supply on the western side of the creek. Native revegetation on the eastern side of the creek would enhance these values and promote connectivity. |
| Groundcover / Biomass Management | Fencing to manage livestock around the creek and steep catchment areas to promote the native groundcover regeneration is highly desirable. This will ensure that the creek is more resilient to the effects of a changing climate (more extreme drought and flooding). |
| Willows and Riparian Woody Weeds | Willow control is a very high priority as there are only a small number of scattered problematic Crack Willows and other willows occur along tributaries. The hydrological and visual impacts of stem injecting willows along the creek would be low impact making it a cost-effective treatment option. |
| Weeds and Feral Animals | Serrated Tussock is a major problem, particularly in inaccessible areas. Priority should be given to protecting areas of high-quality vegetation. There are also patches of Blackberry and Briar that are able to be controlled. Foxes and rabbits remain in high numbers in the area and a regional control program would benefit. |
| Hydrological Enhancement / Erosion Control | As this part of the Jerrabomberra Creek is largely controlled by bedrock there is no need for any structural works. Deposition of sediment is filling some of the pools and inside bends, and this needs to be addressed by reducing sediment loss from the steep slopes and upper parts of the catchment). |

Table 12 Recommended Actions Old Cooma Road to Church Creek

7.4.6 Community Engagement and Funding Opportunities

As there are only a few landholders along this section of the Creek, the interest in undertaking on-ground works and/or protecting sensitive areas will depend on whether they are willing and able to do so. If the landholder(s) on the western side of the creek is not keen or able to fence the creek from livestock, then the outcomes of the efforts of landholder's opposite will be minimal. It would be preferable to incorporate work in this part of the Creek catchment with other projects nearby. If the western landholder(s) is interested in fencing the creek, it could be suitable for an Environmental Trust application and/or the Biodiversity Conservation Trust grant, due to the high number of threatened species.

Project Focus Areas

- Approach landholders on the western side of the creek to gauge their interest in Land for Wildlife, Biodiversity Conservation Trust and other incentives to manage their protect and enhance their biodiversity assets and/or fence the creek.
- If agreeable, a project could be developed specifically for this section of the creek and funding from the Environmental Trust could be applied for (similar to projects at Wandiyali Sanctuary).
- If not agreeable, divert efforts to other areas and incorporate any interested landholders on the eastern side of the creek into other projects where possible.

Next Steps

- Approach landholder(s) as mentioned above and proceed in line with their wishes outlined above.
- Map willow infestations via satellite imagery as this will become a priority for action if the Jerrabomberra Creek is fenced in future.

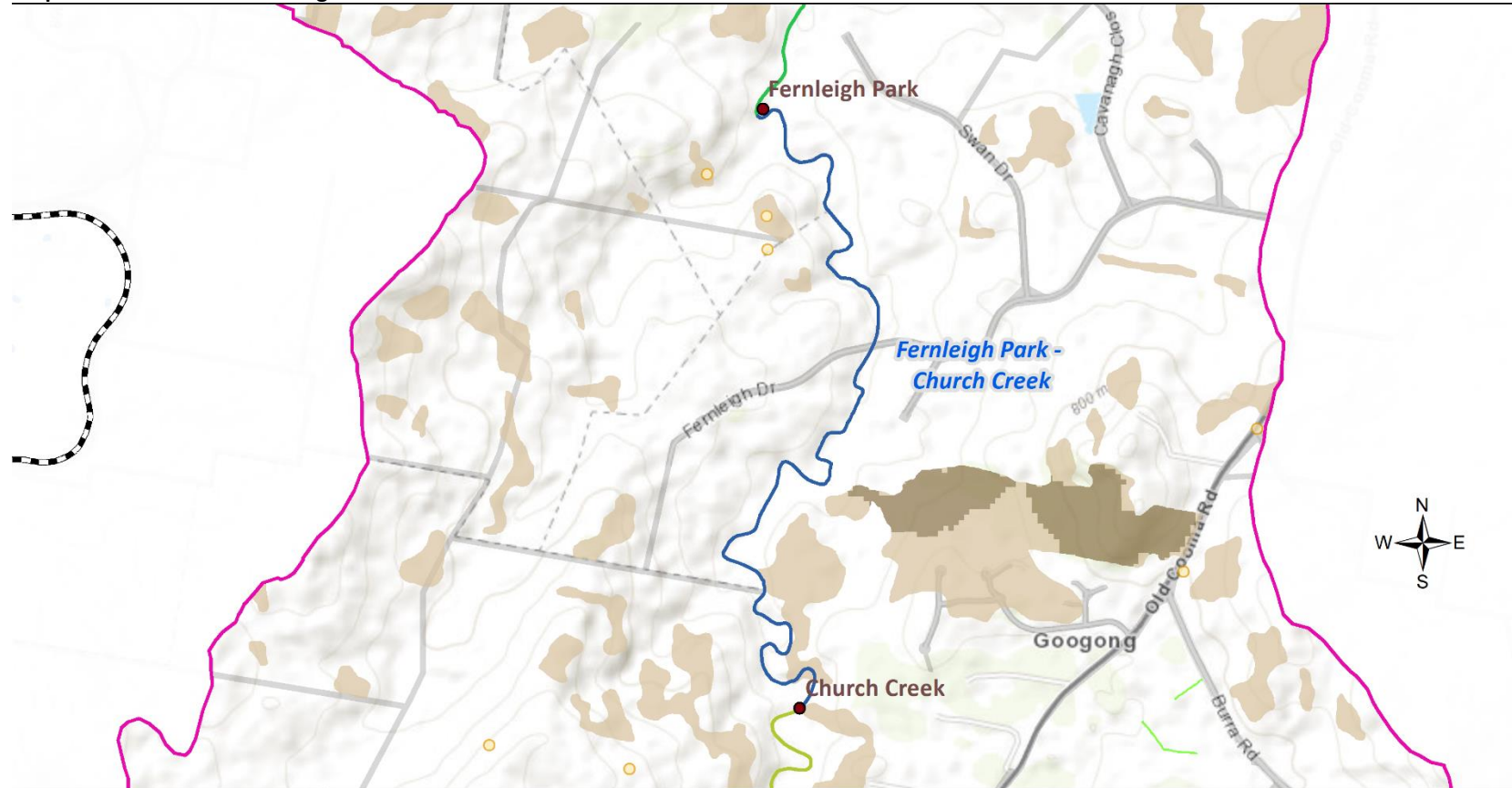
Key Contacts

These are groups that deliver programs and projects in this area, or have done so in the past:

- Molonglo Conservation Group
- South East Local Land Services
- Fernleigh Park or Queanbeyan Landcare
- Biodiversity Conservation Trust

7.5 Section 5 Church Creek to Fernleigh Park

Map 8 Church Creek to Fernleigh Park



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Jerrabomberra Creek Management Sections

- Jerrabomberra - Fernleigh Park
- Fernleigh Park - Church Creek
- Church Creek - Old Cooma Road



Map produced by: **geoADAPT**
4 April 2020

7.5.1 Description

The topography between Church Creek and Fernleigh Park is moderately steep, grading to rolling hills down toward the creek channel. There are some areas of gully erosion in deeper soils on hillsides. The area is dotted with large rural residential subdivisions as well as the development of Fernleigh Park. Some of the creek is fenced from livestock but large sections are not. Land use is oriented towards lifestyle, but the blocks are big enough for people to run a few head of livestock, which can impact on the sections of the creek that are not fenced. To the east, and in the upper parts of this section of the catchment, there is a large patch of dry Sclerophyll forest and sparse open woodland under private land ownership, which appears to be in good condition.

7.5.2 Important Natural Attributes

Endangered Ecological Community-listed Box Gum woodland dominates the upper parts of this section and is connected across the landscape to the west of the Jerrabomberra Creek. The vegetation in the areas to the east and north of Fernleigh Park has been extensively cleared. Groundcover is dominated by native pastures and there are some threatened species occurring in pockets where vegetation is intact. Threatened species, which occur in the more natural areas to the east, are listed in Table 13.

Table 13 Threatened species recorded between Church Creek and Fernleigh Park (V = Vulnerable P = Protected (NSW), E = Endangered)

| Species | Common Name | Listing NSW | Listing Federal |
|----------------------------------|------------------|-------------|-----------------|
| <i>Daphoenositta chrysoptera</i> | Varied Sittella | V,P | |
| <i>Petroica boodang</i> | Scarlet Robin | V,P | |
| <i>Petroica phoenicea</i> | Flame Robin | V,P | |
| <i>Pyrrholaemus sagittatus</i> | Speckled Warbler | V,P | |
| <i>Leucochrysum albicans</i> | Hoary Sunray | | E |

(Source: NSW Government Bionet)

7.5.3 Threats

The main threats are associated with rural residential development (infrastructure and high intensity land use), vegetation loss, erosion, sedimentation of the creek and exotic plants (such as Serrated Tussock, African Love Grass, St John's Wort, Briar, Blackberry and Patterson's Curse) invading large areas of (mostly) native pasture. Woody weeds are common along the creek channel and consist of problem Willows, Hawthorn and Blackberry. These are still at a level where a control program is feasible (if landholders were to get on board). The variability in landscape integrity reflects the high diversity among landholders, with some managing their blocks for conservation and others managing for lifestyle with little understanding of the natural landscape. This is illustrated in Figure 9.

Figure 9 A mixture of land use, from scattered remnant woodland (dark grey vegetation) through to cleared native pastures, weed dominated areas (light green clumps) to a purely urban landscape.



7.5.4 Past and Current Projects

This area provides an opportunity for concerted community effort, as it is potentially the most impacted in terms of threats to natural values and water quality. There is a Landcare Group in the Fernleigh Park area, coordinated through the Queanbeyan Landcare Group, that has undertaken a number of Landcare projects.

7.5.5 Recommended Actions

| Target Area for Action | Details |
|----------------------------------|---|
| Vegetation Enhancement | While there is good quality vegetation in the upper part of the catchment, there are also some very bare areas that lend themselves to revegetation to connect habitat for wildlife. The creek corridor and existing patches of remnant vegetation are good places to focus attention. |
| Groundcover / Biomass Management | Biomass levels vary from property to property (with numerous small properties) which is both favourable and problematic at the same time. On some properties the lack of grazing has resulted in good biomass and native diversity, along with an ever-increasing weed infestation. On other properties overgrazing has led to loss of groundcover and erosion, but the weeds are kept at bay. There are also a number of landholders who manage grazing and weeds very well. The area is a mosaic of land management variability, with areas of intact native pastures in patches. |
| Willows and Riparian Woody Weeds | Willows are extensive in this section of Jerrabomberra creek due to lower grazing pressure. With landholder support they can be controlled. Some of the higher infestations would need to be assessed for downstream risk relating to woody debris. A detailed plan to manage the infestations would need to be developed prior to any action taking place. |
| Weeds and Feral Animals | There are some significant patches of Blackberry, Briar, Serrated Tussock and other weeds within the catchment that need to be managed. A weed awareness campaign would be beneficial. Foxes and rabbits are not controlled in any coordinated way and this is another area requiring action. |

| | |
|--|---|
| Hydrological Enhancement / Erosion Control | There are a few areas of gully erosion leading into the Jerrabomberra Creek, but this section is largely stable. In the Jerrabomberra creek channel itself, there is significant sediment deposition due to the flat channel floor which erodes and deposits depending on flow velocity. Bedrock mostly controls the course of the channel and erosion risk is low. |
|--|---|

Table 14 Recommended Actions Church Creek to Fernleigh Park

7.5.6 Future Community Engagement and Funding Opportunities

An incentives-based community engagement program could be developed in this area with one of the more mobile, threatened species, such as the Scarlet or Flame Robin, as a focus. These birds have provided a successful focal point for other projects undertaken to protect and enhance remnant vegetation. In this case the aim would be to return habitat to the landscape, including along the creek. Funding could potentially be obtained from the NSW Environmental Trust, local Council and/or National Landcare Program grants for threatened species. Working with those landholders who own high conservation value riparian areas could result in large sections of the creek being protected.

Project Focus Areas

- To raise awareness about the importance of native vegetation as habitat for wildlife, as well as weed management and riparian rehabilitation for water quality.
- Strategic revegetation to connect habitat for threatened bird species (as a community focus area).
- Riparian rehabilitation.

Next Steps

- Make contact with potential partners about the development of a program and undertake a community analysis to gauge knowledge and interest levels. This could be done via social media, letterbox drops, direct contact and/or existing community networks, and Council communications.
- Develop a community awareness raising campaign (community get-togethers, farm walks etc.) about threatened species such as Scarlet and Flame Robins that incorporates ways in which people can improve the landscape. Topics for discussion would include revegetation, biodiversity enhancement, weed management and riparian rehabilitation, in conjunction with an incentives program.
- Development of a willow and weed management strategy outlining control priorities, landholder consultation, and estimated cost, funding opportunities and risk. Incentives will need to include some level of weed control being a major threat to biodiversity (with some infestations beyond landholder capacity).
- Set up photo monitoring points.

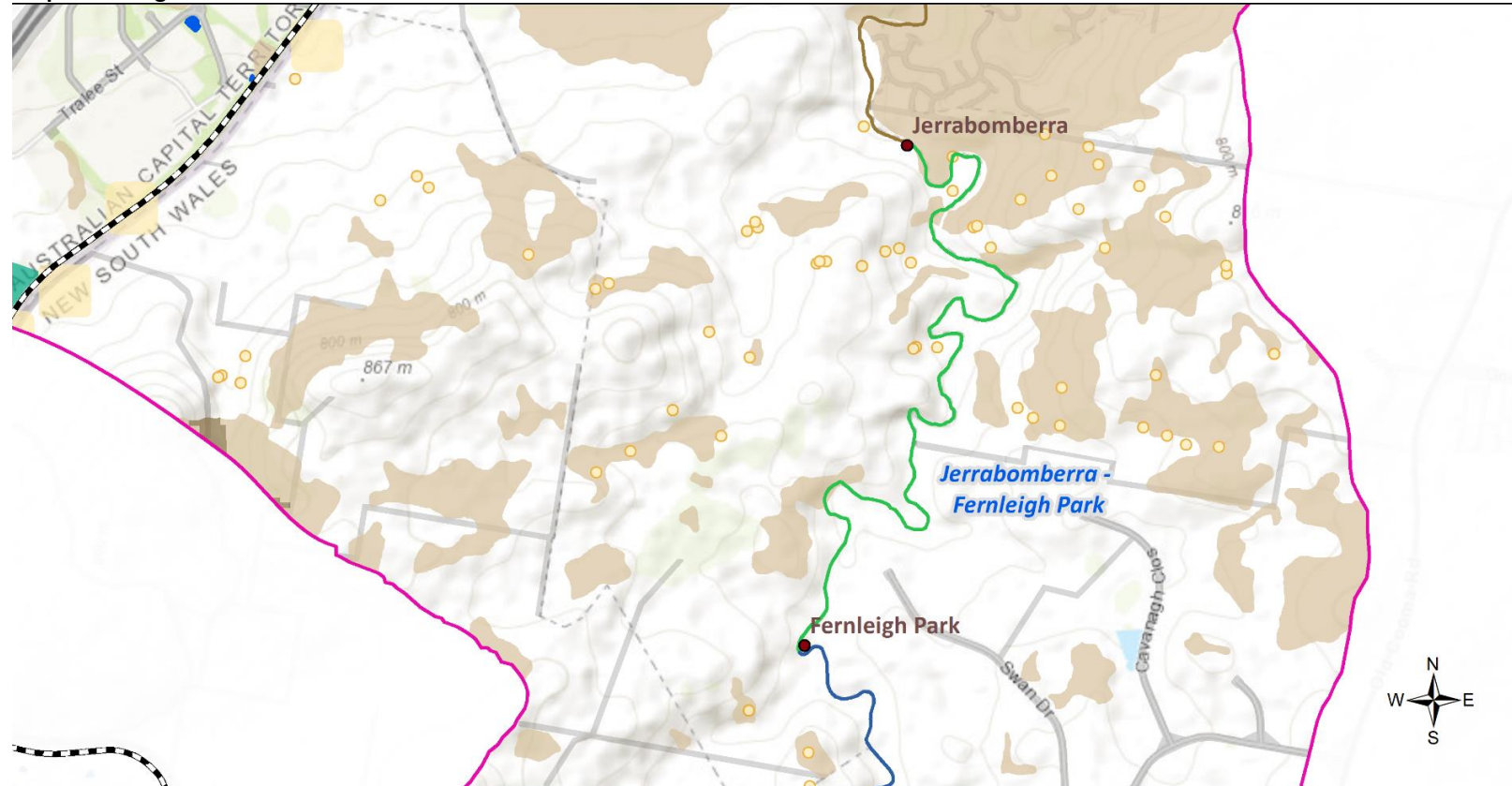
Key Contacts

These are groups that deliver programs and projects in this area, or have done so in the past:

- Queanbeyan Landcare
- Molonglo Catchment Group
- Queanbeyan Palerang Regional Council
- Small Farms Network
- South East Local Land Services

7.6 Section 6 Fernleigh Park to Jerrabomberra

Map 9 Fernleigh Park to Jerrabomberra



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- ACT - NSW Border
- Planning Boundary
- Important Wetlands
- Nature Reserves
- Roads
- Blocks & Lots

- Threatened Species
- Grasslands
- Woodlands
- Dry Sclerophyll

Jerrabomberra Creek Management Sections

- ACT/NSW Border - Jerrabomberra
- Jerrabomberra - Fernleigh Park
- Fernleigh Park - Church Creek



Map produced by: **geoADAPT**
4 April 2020

7.6.1 Description

Most of this section of the Jerrabomberra Creek Catchment is managed for conservation and sustainable agriculture. On the eastern side there is an ex-grazing property which has been turned into a wildlife sanctuary (Wandiyali Sanctuary) and conserves Endangered Ecological Community-listed Box Gum Woodland, native grasslands, Jerrabomberra Creek and numerous threatened species. It showcases a 'reference' condition landscape and provides insights into what the landscape once looked like before modification. There are also many areas of Indigenous cultural significance on the property which have been conserved.

Across the creek from Wandiyali Sanctuary to the west, is large cattle grazing property 'Environa', where conservation and production are managed sustainably. Marginal land, and areas of high conservation have been fenced from livestock and/or revegetated, and a rotational grazing system to protect groundcover is used. Upstream from these properties there are several proactive and conservation-minded landholders who are also managing their properties for biodiversity. Landholders have worked together to fence the Jerrabomberra Creek and its tributaries in order to remove livestock to protect vegetation; they have controlled all the problem willows, planted native vegetation, added woody debris, controlled erosion and continue to work with Queanbeyan Palerang Regional Council, Queanbeyan Landcare, Molonglo Catchment Group and many other stakeholders to maintain and improve the environment. Between them, these landholders and council are conserving around 800 hectares of land.

7.6.2 Important Natural Attributes

This large complex of intact or improving Endangered Ecological Community-listed Box Gum Woodland is home to numerous threatened plant and animal species, which are listed in Table 8. The Jerrabomberra Creek in this area is protected from livestock grazing and is actively managed for biodiversity and water quality. The country is steep as it drops towards the river, which adds to the complexity of habitat availability, and provides the added benefits of rocky outcrops, woody debris, mosaic woodlands and open grassy areas, creeks, dams and ephemeral drainage lines. The Wandiyali Conservation Trust is in the process of constructing a predator-proof fence with the aim of reintroducing endangered wildlife in the future. Table 15 provides a list of threatened species.

Table 15 Threatened species recorded between Fernleigh Park and Jerrabomberra (V = Vulnerable P = Protected (NSW), E = Endangered, CE= Critically Endangered)

| Species | Common Name | Listing NSW | Listing Federal |
|---------------------------------------|-----------------------------|-------------|-----------------|
| <i>Aprasia parapulchella</i> | Pink-tailed Legless Lizard | V,P | V |
| <i>Synemon plana</i> | Golden Sun Moth | E | CE |
| <i>Miniopterus schreibersii</i> | Large Bent-winged Bat | V,P | |
| <i>Artamus cyanopterus</i> | Dusky Woodswallow | V,P | |
| <i>Climacteris picumnus victoriae</i> | Brown Treecreeper (eastern) | V,P | |
| <i>Daphoenositta chrysoptera</i> | Varied Sittella | V,P | |
| <i>Petroica boodang</i> | Scarlet Robin | V,P | |
| <i>Pyrrholaemus sagittatus</i> | Speckled Warbler | V,P | |
| <i>Stagonopleura guttata</i> | Diamond Firetail | V,P | |
| <i>Leucochrysum albicans</i> | Hoary Sunray | | E |
| <i>Swainsona sericea</i> | Silky Swainson-pea | V | |

(Source: NSW Government Bionet)

7.6.3 Threats

The main threats are weeds and feral animals such as foxes and rabbits. Landholders continue to manage feral animal numbers as part of ongoing programs, which are for the most part under control (noting that numbers go up and down depending on the season). As mentioned above, Wandiyali Conservation Trust is in the process of constructing a predator-proof fence. It should be noted that native animals can also be problematic in high

numbers particularly eastern grey Kangaroos and management of these are part of the conservation plan for the property.

7.6.4 Past and Current Projects

Owners of both Wandiyali Sanctuary and ‘Environa’, along with a variety of partners and volunteers, have undertaken numerous projects to protect sensitive areas and enhance the landscape. These include:

- Jerrabomberra Creek Rehabilitation Project: fencing, revegetation and controlling willows along Jerrabomberra Creek between five properties, with Molonglo Catchment Group and Greening Australia.
- Glossy Black Cockatoo Project: revegetation of *Casuarina verticillata* with Greening Australia.
- Saving our Scarlet Robin: revegetation with South East Local Land Service and Molonglo Catchment Group.
- Stringybark to ‘Environa’: fencing, revegetation, bird surveys and Vegwatch with Queanbeyan Palerang Regional Council, Molonglo Catchment Group and Queanbeyan Landcare.
- Pott’s Creek/Jasper’s Gorge Project: fencing, revegetation, Vegwatch and bird surveys.
- Land for Wildlife registration.
- Plantings with various groups including Australian National University Intrepid Landcare, Green Army, Australian Defence Force Academy cadets, Landcare and others.

Future directions for Wandiyali Conservation Trust include working with Traditional Owners to look at a variety of options for land management, in particular, cultural burning opportunities. They are also keen to set up a more comprehensive monitoring program to assess biodiversity outcomes in more detail. They have set up photo monitoring points and undertaken Vegwatch and bird surveys. The owners of ‘Environa’ along with their upstream neighbours will continue with projects as they arise and that are in alignment with land management outcomes (production, conservation and/or lifestyle).

7.6.5 Recommended Actions

| Target Area for Action | Details |
|--|--|
| Vegetation Enhancement | Vegetation is in ‘reference’ or high-quality condition and other than ongoing revegetation in some barer areas, weed control and minor erosion works, there is a need to protect and maintain. |
| Groundcover / Biomass Management | Groundcover varies depending on drought and pressures from cattle and kangaroos. The inclusion of woody debris in patches throughout key locations has created small areas where groundcover is protected from grazing. Some steep areas experienced high soil loss due to hail and heavy rains, but these are now healing, with some soft engineering solutions such as silt fencing and hay bales. Wombats are also creating issues in some areas on Wandiyali where they are upending the native <i>Poa</i> Tussocks. |
| Willows and Riparian Woody Weeds | There are no problematic willows along the creek following their eradication in 2017. Other woody weeds are under control. |
| Weeds and Feral Animals | Weeds and feral animals consist mostly of foxes and rabbits and are an ongoing concern. This issue will ultimately be addressed on Wandiyali Sanctuary with a predator-proof fence, but other landholders will need to continue with control programs. |
| Hydrological Enhancement / Erosion Control | Overall, the area is stable, with small scale movement of soil in response to drought and heavy rain. A continuation of the soft engineering works is recommended. |

Table 16 Recommended Actions Fernleigh Park to Jerrabomberra

7.6.6 Future Community Engagement and Funding Opportunities

The community in this stretch of the Jerrabomberra Creek are working together to create a mosaic of protected, high-quality, threatened vegetation communities, and provide a showcase of sound environmental management and sustainable production. From the tops of the hills to the bottom of the Creek, the landscape provides a reference for these vegetation communities in other parts of the landscape. It also shows how landholders can work together towards common goals.

Project Focus Areas

- To work with Wandiyali Conservation Trust to raise awareness in the broader community about the importance of native vegetation, biodiversity and water quality and to showcase management options.
- Connect with Traditional Owners to investigate traditional land management opportunities to manage the landscape.
- Continue with revegetation, small scale erosion control works, and ongoing weed, willow and feral animal management.

Next Steps

- Work with Wandiyali Sanctuary owners to set up a more comprehensive monitoring program for the property.
- Discuss with the owners of Wandiyali Sanctuary about the potential of program of field days or farm walks targeting community members in key areas in the catchment where projects need to be developed. These could also be community get together days.
- Continue to liaise with 'Environa' owners and other neighbouring landholders to support new opportunities (e.g., through the Biodiversity Conservation Trust and other threatened species programs).

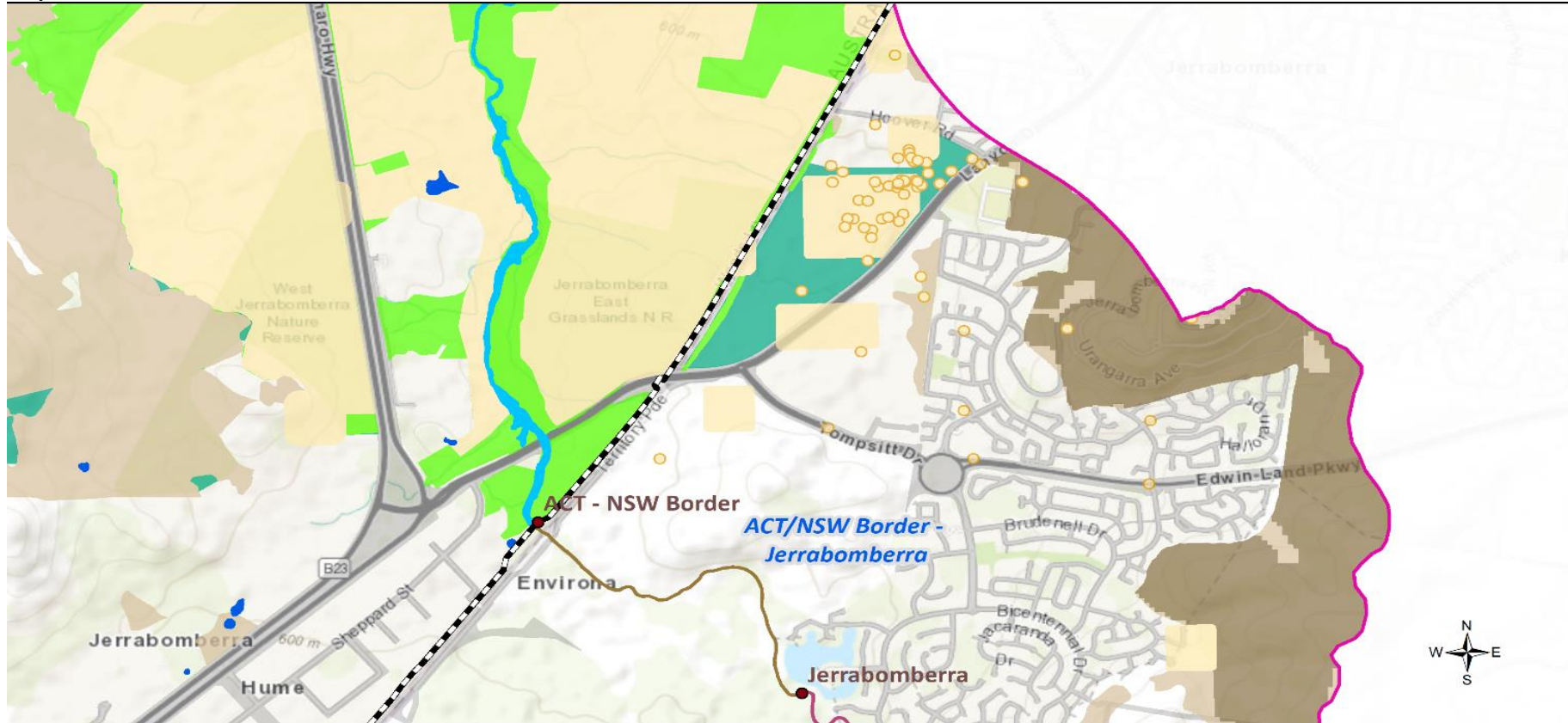
Key Contacts

These are groups that deliver programs and projects in this area, or have done so in the past:

- Wandiyali Conservation Trust
- Environa
- Molonglo Conservation Group
- Queanbeyan Landcare
- Queanbeyan Palerang Regional Council
- South East Local Land Services
- Greening Australia

7.7 Section 7 Jerrabomberra to the ACT Border

Map 10 Jerrabomberra to ACT Border



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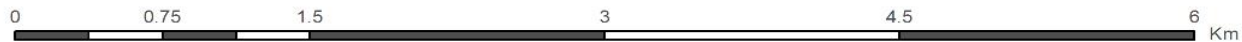
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The spatial data presented synthesises best available evidence relating to hydrology; however, it is meant to guide, not replace, field validation.

- ACT - NSW Border
- Planning Boundary
- Important Wetlands
- Nature Reserves
- Roads
- Blocks & Lots
- Threatened Species
- Grasslands
- Woodlands
- Dry Sclerophyll

Jerrabomberra Creek Management Sections

- Narrabundah - ACT/NSW Border
- ACT/NSW Border - Jerrabomberra
- Jerrabomberra - Fernleigh Park



Map produced by: **geoADAPT**
25 March 2020

7.7.1 Description

This section of the Jerrabomberra Creek Catchment is highly modified from its original condition and includes the suburb of Jerrabomberra down to the ACT border. The Jerrabomberra Creek, as it flows through the suburb of Jerrabomberra, has been modified through creek realignment, rock armouring of outer bends and a dominance of exotic vegetation such as willows, elms, Hawthorns, poplars and other European vegetation. Lake Jerrabomberra is situated very close to the creek but is not part of the creek itself. There is some native vegetation, but exotic species dominate. The area around Lake Jerrabomberra and the Jerrabomberra creek provides opportunities for recreation as well as drainage and sediment control. As the creek flows towards the NSW ACT border, past the industrial area of Hume, the condition of the riparian zone is very poor, with the overstorey being mostly exotic. Banks are relatively stable but there is still a high amount of exposed soil on the creek banks, and areas of active erosion. Just before the creek reaches the border, however, there is a patch of native grassland, and although threatened by various weed species, it is in good condition. This has been recognised in development plans for the area.

Almost the entire area is earmarked for the South Jerrabomberra Development as shown in Figure 10 however some areas have been set aside for conservation. The orange shows a designated conservation area, including the grasslands and the Jerrabomberra Creek, which will provide opportunities for the community to get involved in improving conditions of these areas, and (ideally) investment in rehabilitation.

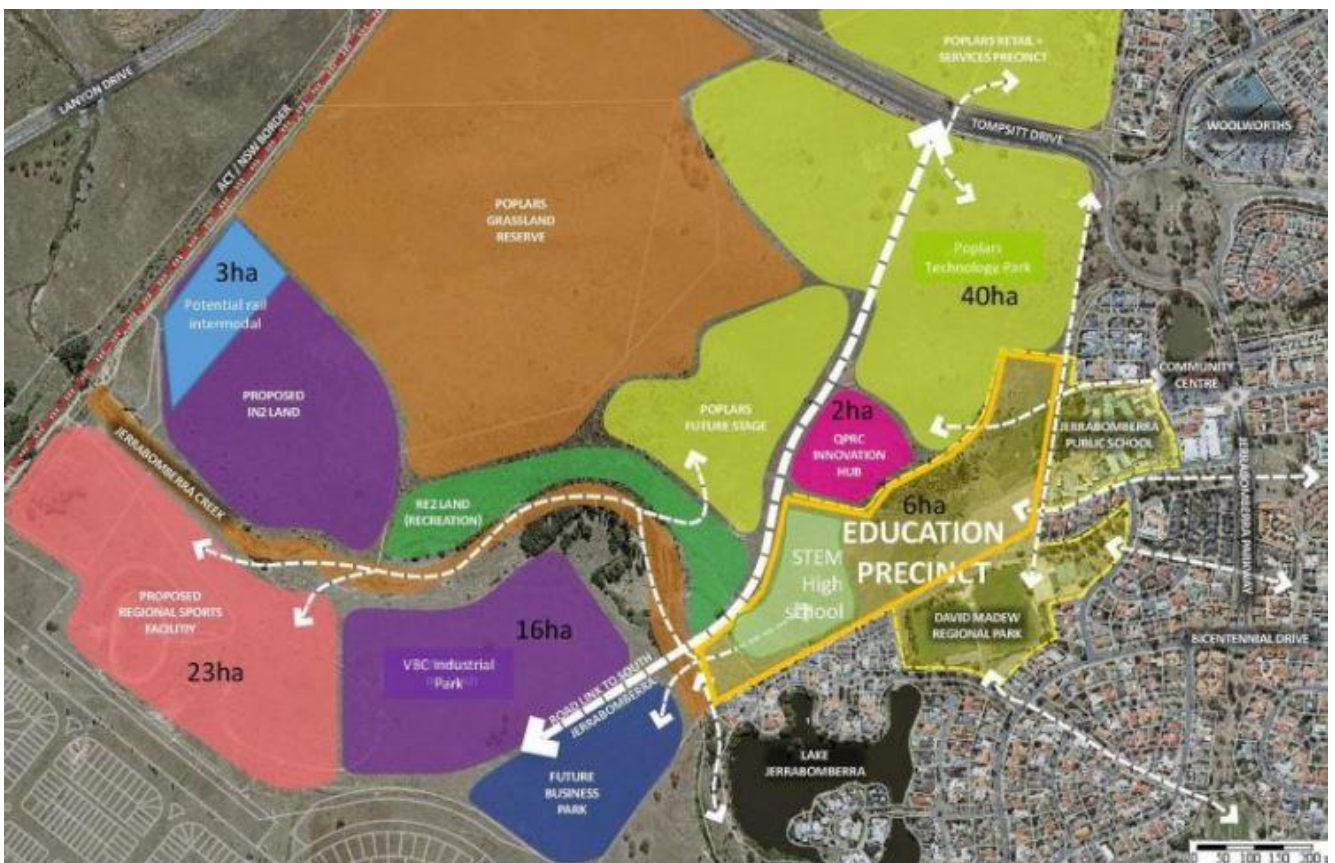


Figure 10 The layout for the South Jerrabomberra Innovation Precinct. Source: QPRC (2020).

7.7.2 Important Natural Attributes

There are few natural attributes along the creek area as it has been significantly modified, however, there are a significant number of natural values higher up in the catchment area, in particular Endangered Ecological Community-listed natural temperate grasslands. This area hosts a diversity of threatened species, listed in Table 17.

Table 17 Threatened species recorded between Jerrabomberra and the ACT Border
(V = Vulnerable P = Protected (NSW), E = Endangered, CE= Critically Endangered)

| Species | Common Name | Listing NSW | Listing Federal |
|-----------------------------------|--------------------------|-------------|-----------------|
| <i>Aprasia parapulchella</i> | Pink-tailed Worm-lizard | V,P | V |
| <i>Tympanocryptis pinguicolla</i> | Grassland Earless Dragon | E, P | E |
| <i>Artamus cyanopterus</i> | Dusky Woodswallow | V,P | |
| <i>Daphoenositta chrysoptera</i> | Varied Sittella | V,P | |
| <i>Hieraaetus morphnoides</i> | Little Eagle | V,P | |
| <i>Petroica phoenicea</i> | Flame Robin | V,P | |
| <i>Synemon plana</i> | Golden Sun Moth | E | CE |
| <i>Rutidosia leptorhynchoides</i> | Button Wrinklewort | E | E |
| <i>Leucochrysum albicans</i> | Hoary Sunray | | E |

(Source: NSW Government Bionet)

7.7.3 Threats

The main threats are a lack of native riparian vegetation and a dominance of exotic vegetation, which in many areas is dominating entire sections of the creek. The creek in this area is stable geomorphically.

7.7.4 Past and Current Projects

There have been no active community projects along this section of the creek, although there is great interest in the preservation of the grassland area east of the creek which is designated as conservation area (as is the creek). The Jerrabomberra area has an active community who undertake projects in the local Bicentennial Park and around Mount Jerrabomberra as part of Queanbeyan Landcare.

7.7.5 Recommended Actions

| Target Area for Action | Details |
|----------------------------------|---|
| Vegetation Enhancement | Native revegetation should target the section of creek downstream of the suburb of Jerrabomberra, targeting the higher elevations. Areas of intact grassland should not be revegetated but managed for weeds and other threats. The section of creek adjacent to the suburb of Jerrabomberra is a low priority for revegetation due to the high level of exotic species. Plans to rehabilitate this area would need to follow a staged approach and are likely to be expensive. |
| Groundcover / Biomass Management | Native groundcover along the creek should be fostered and weed invasions should be contained and managed to promote diversity of perennial deep-rooted native vegetation. Areas of high-quality grasslands should not be planted with trees. |
| Willows and Riparian Woody Weeds | Willows and woody weeds are a major threat to the creek with containment rather than the control the intermediate goal. The highest priority is to keep woody weeds out of areas that they have not yet colonised, and to work outwards to reduce spread and impacts. Removal attempts would require a well-considered, detailed, costed and staged plan with a high level of community consultation. |
| Weeds and Feral Animals | Noxious weeds are a major threat and a high priority for control. The area needs to be actively managed to ensure that the integrity of the important grasslands is maintained, as well as the creek corridor, and to reduce the spread downstream into the important Jerrabomberra Grasslands. |

| | |
|--|---|
| Hydrological Enhancement / Erosion Control | The maintenance of groundcover will assist the stabilisation of bank and gully erosion; however, an assessment of the creek is needed to identify areas that may require more substantial works. It is unlikely that significant structural works will be required. |
|--|---|

Table 18 Recommended Actions Jerrabomberra to ACT Border

7.7.6 Future Community Engagement and Funding Opportunities

The opportunity for community engagement is very high, with Queanbeyan Landcare along with interested residents in a good position to be an integral part of environmental projects in this area (if they are not already).

Project Focus Areas

- To develop a practical creek rehabilitation plan, which could provide a focal point for local community efforts and underpin the formation of a local Landcare group (if such plans do not already exist). Focus activities would be weed control (maintaining clean areas), small scale erosion management and revegetation in appropriate areas.
- As part of the Poplars development, a 100ha conservation area consisting of grassland and scattered woodland has been permanently protected under the NSW Government’s Biodiversity Stewardship program.

Next Steps

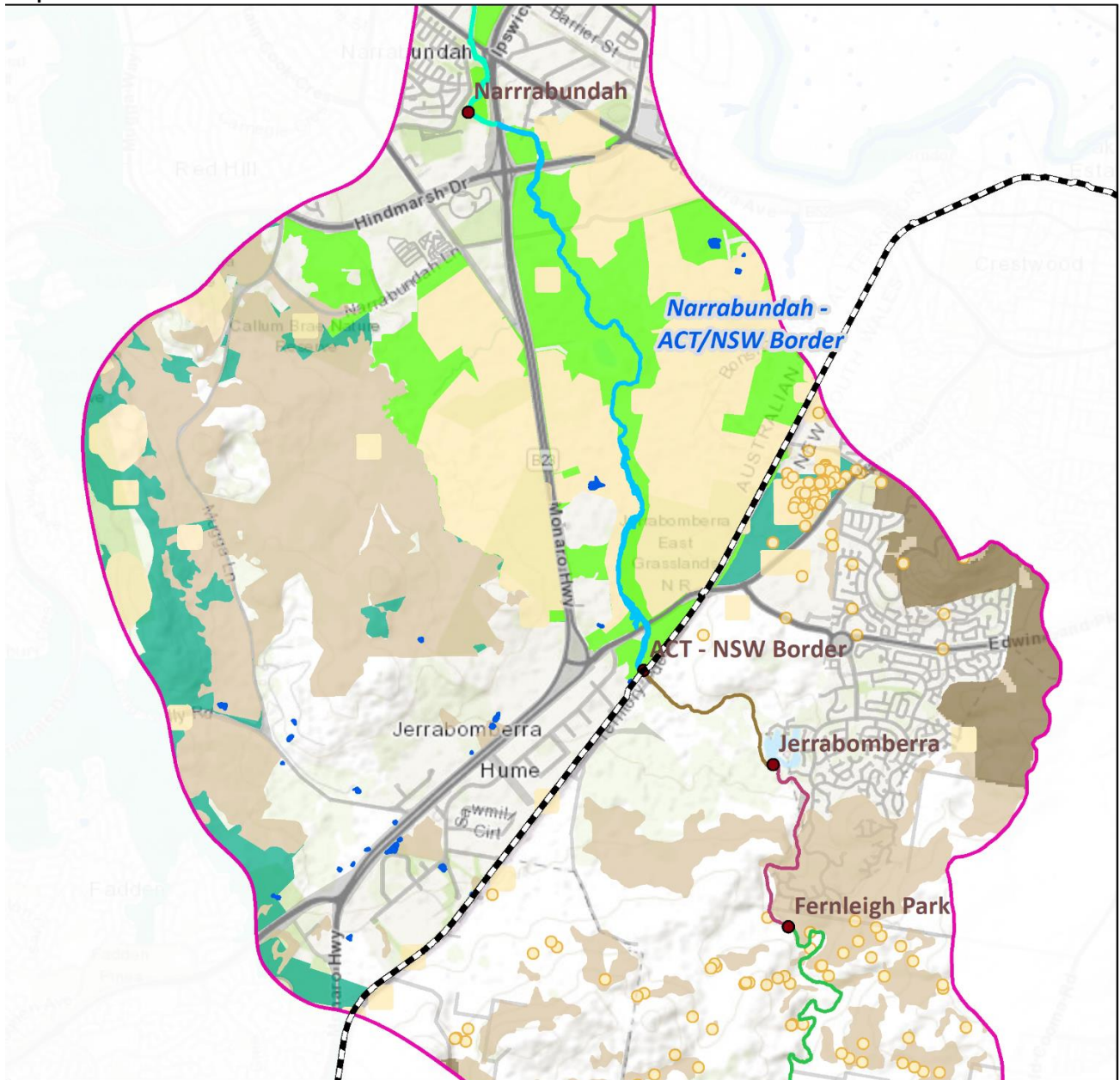
- Liaise with Council and Queanbeyan Landcare Group to see what the future plans for the conservation areas are, and who will be responsible for managing this in future.

Key Contacts

- Queanbeyan Palerang Regional Council
- Queanbeyan Landcare (including ‘Friends of’ groups in Jerrabomberra)
- ACT PCS (neighbouring Jerrabomberra East Grassland Reserve)

7.8 Section 8 ACT Border to Narrabundah

Map 11 ACT Border to Narrabundah



Jerrabomberra Creek Management Sections

- Jerrabomberra Wetlands - Narrabundah
- Narrabundah - ACT/NSW Border
- ACT/NSW Border - Jerrabomberra
- Jerrabomberra - Fernleigh Park
- Fernleigh Park - Four Mile Creek

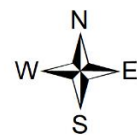
- ACT - NSW Border
- Planning Boundary
- Important Wetlands
- Nature Reserves

- Threatened Species
- Grasslands
- Woodlands
- Dry Sclerophyll
- Blocks & Lots
- Roads

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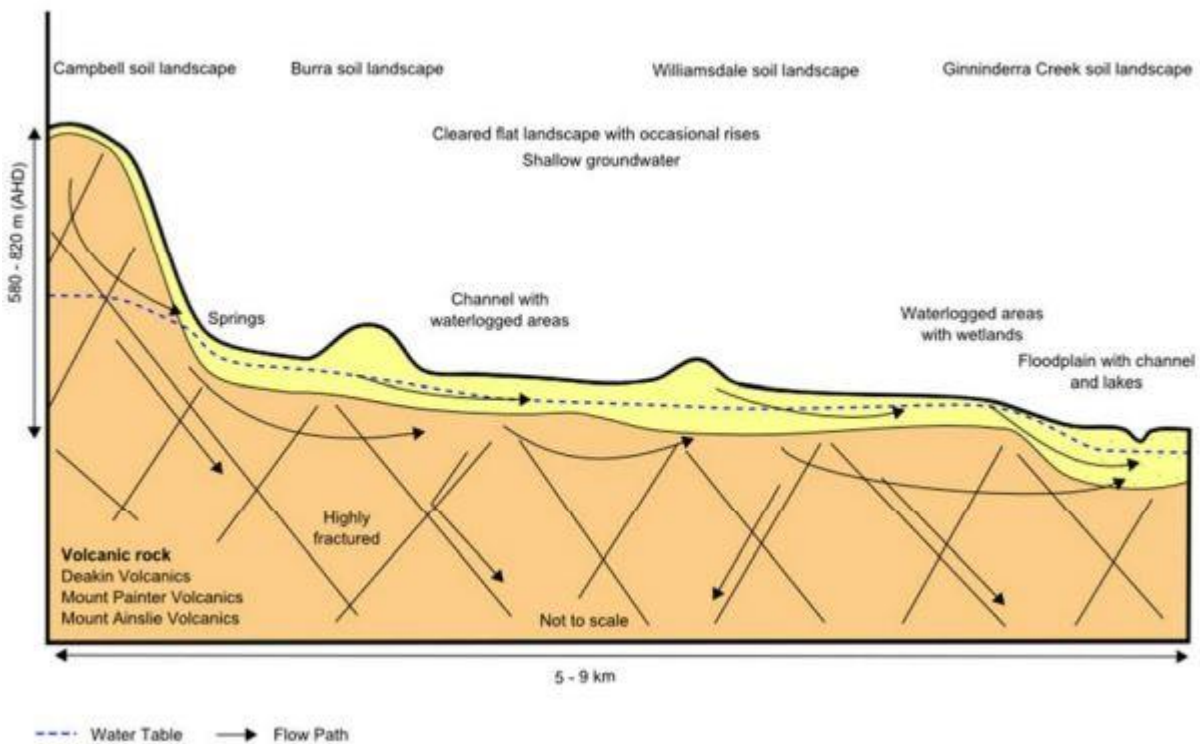
Map produced by: **geoADAPT**
25 March 2020

7.8.1 Description

This section of the Jerrabomberra Creek and catchment has a number of threatened species and is protected under legislation and managed in accordance with the ACT Native Grassland Conservation Strategy and Action Plans (ACT Government 2014). This section of the catchment differs to other parts in that it is entirely managed by the ACT Government. The creek channel and riparian zone are not subject to a specific management plan, however, proposed works, particularly those that alter hydrology, need to be considered with great caution as threatened species occur in the downstream reaches. One species of note is a population of the Ginninderra Peppercress, which may be adversely impacted by changes to hydrological regimes in the catchment more broadly (ACT Government 2014). A precautionary approach needs to be adopted when management planning or undertaking any actions.

Figure 11 shows the topography of the catchment and the flow of water from the steep upper slopes down to the flat valley floor and creek channel. There are numerous tributaries that flow into the creek across the flat landscape, which is prone to waterlogging.

Figure 11 shows the conceptual landscape for the Symonston HGL area (adapted from Wooldridge 2015). The Jerrabomberra creek is in the valley to the right of the diagram.



It is commonly believed that the valley floor was once a swampy meadow which became channelised due to agriculture and grazing of protective groundcover, along with increased flows in the catchment from clearing and runoff. Given its position in the landscape, it is unlikely the area was heavily vegetated, although there are some remnant trees on higher elevations along the creek.

The creek is deeply incised, however, the channel's capacity to cope with flows matches the rate of catchment runoff, and, as a result, is not incising further. Emergent aquatic plants have established on the channel floor and are facilitating a return to a swampy meadow system which occurs when plants stabilise soils via their roots and trap sediments as the water flows through them. There are some lateral head cuts (or nick points) perpendicular to the main channel that are mostly stable.

The grassland through which the Jerrabomberra Creek flows are of high ecological value with diverse native grassland species in the drier areas and remnants of swampy vegetation in the wetter areas. There is a mixture of native and exotic grasses and a number of annual weeds which have colonised previously bare areas created by drought. There is no mid or overstorey along the creek other than some small Crack Willows, but it is unlikely that the creek was ever significantly wooded. Outside the reserve area downstream, the creek flows through

(mostly) horse agistment areas towards north Symonston. There is a flood retention basin south of the junction between Hindmarsh Drive and the Monaro Highway which was designed to reduce the risk of flooding the suburban area downstream.

7.8.2 Important Natural Attributes

The Jerrabomberra West Nature Reserve, and Jerrabomberra East and Bonshaw Grasslands offset area (soon to be nature reserve) are over 600 hectares in total; and together they form one of the largest areas of Natural Temperate Grassland in the ACT. These reserves provide an example of the ‘treeless plains’ and woodland transition area that were typical of the Canberra region before European settlement. The grasslands are a diverse ecosystem, providing a haven for both common and endangered plant and animal species.

These reserves form part of a large grassland–woodland complex of over 1000 hectares, which is one of the largest, best connected and most diverse areas of box–gum grassy woodland remaining in Australia (ACT Government 2020). This ancient ecosystem was once widespread from the northern end of NSW down into Victoria. The region is part of the traditional home of the Ngunnawal People. Jerrabomberra West has an important Aboriginal cultural connection in the ACT, with up to four known Aboriginal heritage sites of cultural and archaeological significance.

Both Jerrabomberra West and Jerrabomberra East grasslands are managed by ACT Parks and Conservation Service, which, in addition to protecting these sites and implementing management actions, undertakes research to inform future best practise.

There are a number of threatened species that occur in the grasslands and these are listed in Table 19 There are also patches of secondary native grassland and wetland swampy meadows along the creek area and tributaries.

Table 19 Threatened species recorded between ACT Border and Narrabundah
(V = Vulnerable P = Protected (NSW), E = Endangered, CE= Critically Endangered)

| Species | Common Name | Listing ACT | Listing Federal |
|-----------------------------------|-----------------------------------|-------------|-----------------|
| <i>Aprasia parapulchella</i> | Pink-tailed Worm Lizard | V | V |
| <i>Delma impar</i> | Striped Legless Lizard | V | E |
| <i>Tympanocryptis pinguicolla</i> | Canberra Grassland Earless Dragon | E | E |
| <i>Perunga orachea</i> | Perunga Grasshopper | V | |
| <i>Synemon plana</i> | Golden Sun Moth | CE | CE |
| <i>Lepidium ginninderrense</i> | Ginninderra Peppercross | E | V |
| <i>Schoenus latelaminatus</i> | Medusa Bogsedge | CE | E |

(Source: ACT Government 2014)

7.8.3 Threats

The major threats to the Jerrabomberra Creek are problem willows and exotic trees, which spread very quickly when seasons are favourable. There are two major sources of these exotic species, one upstream of the creek itself, between the Jerrabomberra suburb and the border. The second is an unnamed but major tributary with headwaters that begin near Rose Cottage and flow past Hume. Figure 12 shows the sources of willow and woody weed infestations that have the potential to threaten the integrity of the Jerrabomberra Creek in terms of grassland diversity and hydrological integrity.



Figure 12 Two major sources of potential willow and woody weed infestation in future.

Other threats to the creek vegetation diversity include Serrated Tussock, African Love Grass and annual weeds, such as St John’s Wort and Paterson’s Curse. There are also patches of pasture species such as *Phalaris aquatica*, which can become a monoculture if uncontrolled.

Channelisation and erosion in the creek and tributaries from grazing, as well as changes to upstream hydrology and groundcover loss, have effectively drained the landscape. This has resulted in the transformation of species diversity, incorporating a higher proportion of dryland grass species than it once would have sustained, along with the sowing of pasture species, such as Phalaris.

Ongoing overgrazing poses a significant risk to the integrity of the creek channel, irrespective of whether it is domestic livestock, kangaroos, rabbits or other herbivores. Deep rooted perennial native grasses are the key component for stabilisation of soil, especially in a valley floor that was, for the most part, naturally treeless.

7.8.4 Past and Current Projects

There has been a significant amount of monitoring and innovative research undertaken in the grasslands (particularly around biomass management and burning), which has informed land management actions. The focus of these efforts in the Jerrabomberra East Grasslands has been the Grassland Earless Dragon.

7.8.5 Recommended Actions

This section of the Jerrabomberra Creek and its immediate catchment, as an offset reserve, has an identified budget to undertake improvements. It is also this funding that has enabled the development of this Jerrabomberra Catchment Plan. Therefore, unlike other sections of this plan, recommended actions are outlined below in more detail. As the implementation of this plan evolves, and resources allow this can be undertaken for other sections of the catchment also.

Map 12 provides an overview of assets and recommended works along Jerrabomberra Creek where it flows through Jerrabomberra East Grasslands. The associated table provides recommended actions that apply to the whole area and Maps 13-15 provide site specific actions.

Map 12 Jerrabomberra East Grassland Reserve – Overview of Values and Specific On-Ground Works Recommendations



Source: Esri, Imagery, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


Jerrabomberra Creek: Jerrabomberra East Grasslands Focus Area


- █ IN CHANNEL WORKS
- ENVIRONMENTAL OFFSETS
- PROPOSED FENCING
- PROPOSED REVEGETATION WOODLAND
- PROPOSED REVEG POA CAREX ONLY
- ★ THREATENED SPECIES RECORDS_1819
- THREATENED PLANTS



GrassRoots Environmental

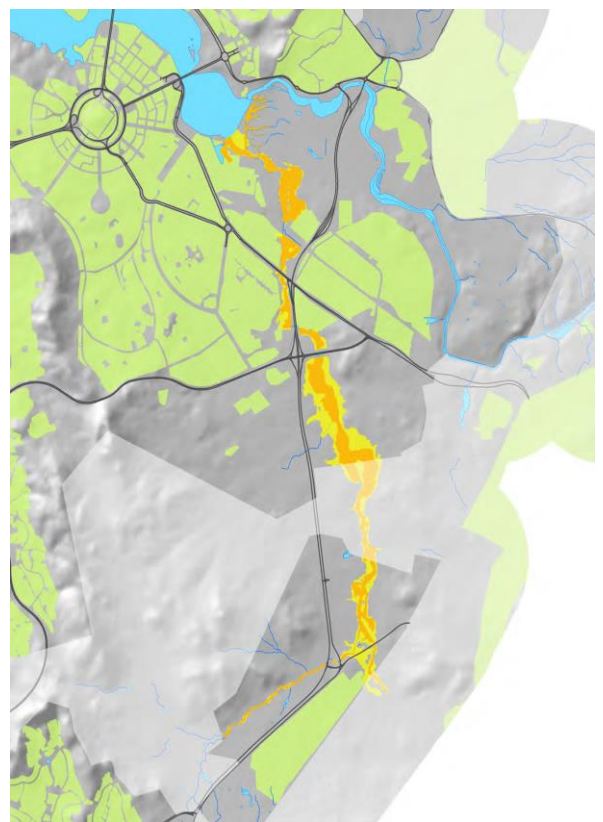
Map prepared by GrassRoots Environmental. While all care is taken to ensure accuracy, it cannot be guaranteed that it is free from errors. Base layers were obtained with permission from the ACT Government spatial database.

| Target Area for Action | Details |
|----------------------------------|--|
| Vegetation Enhancement | <p>The dominant vegetation in this section are grasslands, however, there are some individual or small copses of native trees in areas adjacent to the creek. A number of these are planted Conifers, Willows and Poplars but there are one or two old remnant Eucalypts remaining (particularly near the Lanyon Drive bridge). These remnants indicate that the higher parts of the landscape may once have had scattered trees in transition zones between the woodlands and grasslands. The area now exists as grassland so the requirement for overstorey revegetation is limited. The areas it is recommended is for the purpose of enhancing existing overstorey vegetation and providing habitat for specific species such as the White-winged Triller recorded in the trees adjacent to the creek. New plantings should not be introduced in areas where grassland dominates.</p> <p>Along the creek, damper areas would benefit from planting of locally native groundcover plants, in particular, River Tussock (<i>Poa labillardieri</i>) and Carex (<i>Carex appressa</i>), which are easy to establish, hardy and can withstand a range of conditions from very wet to very dry. In areas dominated by Phalaris, the planting of River Tussock in clumps will gradually provide competition, although it should be recognised that this may take several years.</p> <p>The most important objective for vegetation enhancement is to diversify the aquatic vegetation within the creek channel and ponds by using aquatic plants like <i>Vallisneria australis</i> (Ribbon Weed), <i>Potamogeton sp</i> (Pond Weed), and <i>Myriophyllum sp</i> (Water Milfoil) and emergent plants such as native <i>Juncus sp</i> (Pin Rush), <i>Eleocharis sp</i> (Club Rush), <i>Schoenoplectus sp</i> (Bog Bulrush) and <i>Bulboshoenus sp</i> (March Club Rush). The purpose of this is to increase diversity and stabilise the channel floor, which will in turn increase geomorphic complexity and help the creek return (naturally) to more of a swampy meadow, chain of ponds system. It is doing this in some places already as shown in the adjacent photo. This is a preferable approach than the construction of hard structures as the vegetation grows in response to flow, and there is no risk of further erosion.</p>  |
| Groundcover / Biomass Management | <p>Along with willow control, groundcover and biomass management is one of the most important priorities to improve ecosystem function along Jerrabomberra Creek. Maintaining good groundcover along the creek, and in the catchment more broadly, can be challenging, particularly in drought when grazing pressure is high from (in this case) kangaroos, rabbits and other herbivores which, unlike domestic livestock, are a lot more difficult to manage. The lack of groundcover on grassland and riparian ecosystems is significant, and along the Jerrabomberra Creek there is evidence of weeds infesting bare ground, increased soil loss, and low native grass diversity in many areas.</p> <p>Staff at the Alexander Maconachie Centre have expressed an interest in fencing the creek adjacent to their facility, which will enable better management of livestock for biomass management in future, however it won't address the high numbers of other herbivores. Rather than viewing this as 'fencing the creek', it should be viewed as creating a future grazing management unit. A suggested fence line is shown in Map 14, noting that the actual placement of the fence will need to be determined on-ground in relation to rocks, flood runners and other constraints.</p> |

| | | |
|---|--|---|
| <p>Willows and Riparian Woody Weeds</p> | <p>There are a number of problematic willows growing along the creek channel, with a concentration of them around the bridge over the creek at Lanyon Drive. Due to the small infestation, it is imperative that these are controlled. Targeting them while they are small reduces the effort and risk required to control them, and they can be over sprayed using Glyphosate, or stem injected and left in-situ. One of the tributaries to the Jerrabomberra Creek in this area (Woden Creek) has a large infestation of problem willows and poplars, as does the Jerrabomberra Creek upstream at Jerrabomberra. These will provide an ongoing source of infestation to the grasslands section Jerrabomberra Creek, and ideally needs to be addressed although realistically this is unlikely to occur. The older planted Weeping Willows like the one in this photo do not pose a threat to the integrity of the Creek and can be left in place.</p> |  |
| <p>Weeds and Feral Animals (Biosecurity)</p> | <p>With careful groundcover management, annual weeds should eventually reduce, but any noxious weeds need to be controlled as a matter of high importance in accordance with the ACT Parks and Conservation Service Weed Management Strategy (such as Serrated Tussock, Chilean Needle Grass and African Love Grass). At the time of inspection, this was occurring. Herbaceous weeds can be slashed prior to seeding, to reduce their biomass to enable native grasses and forbs to establish.</p> <p>Feral animals and kangaroo management are addressed as part of broader PCS Management Strategies and their impact was minimal due to the wet season, however during drought, impacts on groundcover are potentially very high in this grass-dominated ecosystem.</p> | |
| <p>Hydrological Enhancement / Erosion Control</p> | <p>Hydrogeological mapping (Wooldridge 2015) suggests that the Jerrabomberra Creek valley floor through this section was once a broad swampy meadow, with several channels that moved back and forth across the valley in response to high flows (as indicated by flood runner channels and ancient depressions). Clearing in the catchment, urban development and agricultural activities have removed groundcover and the channel has become incised in response to the increased flow. Ultimately the channel adjusts to the volume and velocity of flow, and in drought years, the creek channel constricts. In wetter years it expands as it readjusts to the increased flow. This is a natural process, and the key is to ensure that the creek is resilient by having good cover of diverse aquatic and groundcover vegetation. In many areas along the creek, vegetation has already colonised the channel floor and as it traps more and more sediment, the base of the channel builds up. As the vegetation slows the flow, sediment drops out in shallower areas, enabling more vegetation to grow. This effectively forms an in-channel chain of ponds system as the creek stabilises. The photo below shows sediment being trapped behind in-stream vegetation.</p> | |



In spite of the desire to speed this recovery process up using in-stream structural works, it is not recommended. This is because in order to bring the channel height up to ground level, a significant number of large structures will be required to withstand the flow rate during floods. These structures would need to be installed along most of the length of the creek to have an impact on water retention. Structures like these are expensive and carry a high risk of ecological disturbance as they will reduce the capacity of the channel to absorb floodwaters from ever increasing development in the upper parts of the catchment. The Jerrabomberra Creek in the ACT is also a designated flood retention area. The predicted flood risk modelling undertaken by the ACT Government, is shown in Figures 13 and 14.



Figures 13 and 14 show modelled flood extents for a 1 in 100 year event and a 1 in 5 year event (ACTMAPi ACT Government 2020)

This section of the Jerrabomberra Creek, all the way through to Narrabundah, is an important floodwater retention area; in particular the Hindmarsh Drive embankment, which provides an effective holding basin for flood waters in addition to the creek itself (ACT Government 2018). This is another reason why installation of solid in-stream structures is not appropriate for Jerrabomberra Creek. Although they will reduce the velocity of floodwaters and potentially spread water out over the floodplain (assuming enough of them were constructed), they will also expand the area of flooding impact. This would necessitate updated flood modelling to ensure there was no increased risk to dwellings and infrastructure downstream.

An alternative to hard in-stream structures, it is preferable to assess the creek to look for opportunities for the placement of small-scale flexible structures and aquatic vegetation in key areas that build on the processes that are already occurring as they help to diversify structure within the channel and provide more complexity. Examples of such measures include: the careful placement of woody debris to trap sediment and promote the recolonisation of vegetation, the placement of rock and / or coir logs in unstable areas along the bank toe, planting of aquatic vegetation, placement of bed control structures in the form of rock riffles to promote groundcover on the channel floor. This 'bed building' is happening naturally in places as the adjacent photo shows with reeds, rock riffles, woody debris and natural bank attrition.



Adding or removing large wood (snags) in streams has very little effect on overbank floods as any effects of the wood are 'drowned out'. However, for a flood that remains within the channel, the cross-sectional area of the wood would need to be at least 10% of the area of the channel before it will have an appreciable effect on the stage height (Rutherford 2002). If the wood is angled at 40 degrees to the flow (e.g., with the upstream end of a log against the bank) its effect is reduced further. Vegetation growing in the channel bed has more influence on flow than vegetation on the top of the bank, but as it is flexible and lies down during a flood event, then it has little effect on the flood stage when compared to hard structures. The photo below shows an example of in-

stream woody debris which is offering protection to the bank and in-stream aquatic vegetation lying flat in response to a recent high flow. It is these natural processes that should be replicated.

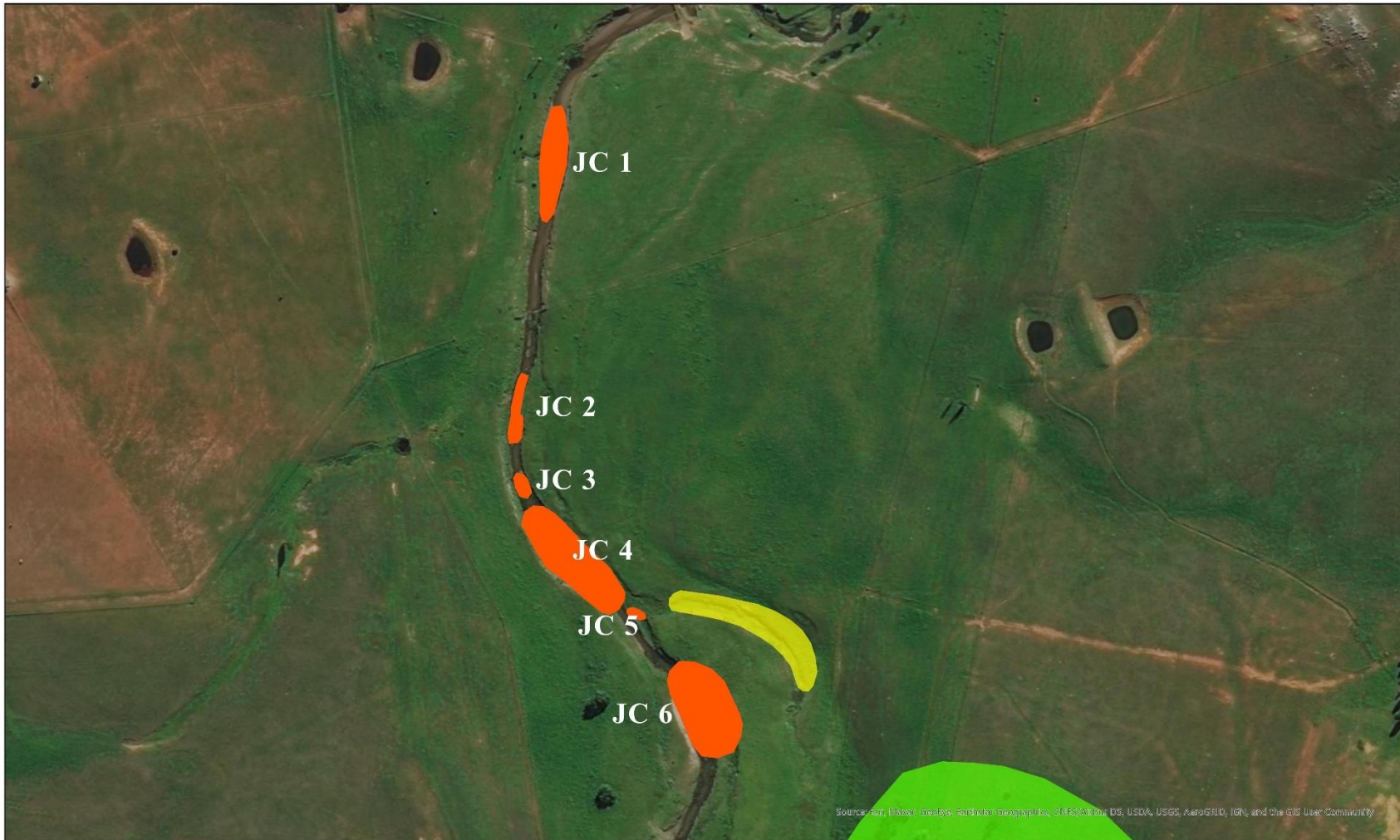
Maps 13 – 15 provide some ideas for in-stream works in specific places as well as locations for revegetation and fencing. This is in addition to the general recommendations already provided in this section.



Table 20 Recommended Actions ACT Border to Narrabundah

7.8.6 On Ground Works Plan

Map 13 Jerrabomberra Creek Jerrabomberra East Grasslands Northern Section



Jerrabomberra Creek in Jerrabomberra Grasslands: Northern Section On-Ground Works

- IN CHANNEL WORKS
- PROPOSED REVEGETATION WOODLAND
- PROPOSED REVEG POA CAREX ONLY

0 0.05 0.1 0.2 Kilometers



GrassRoots Environmental

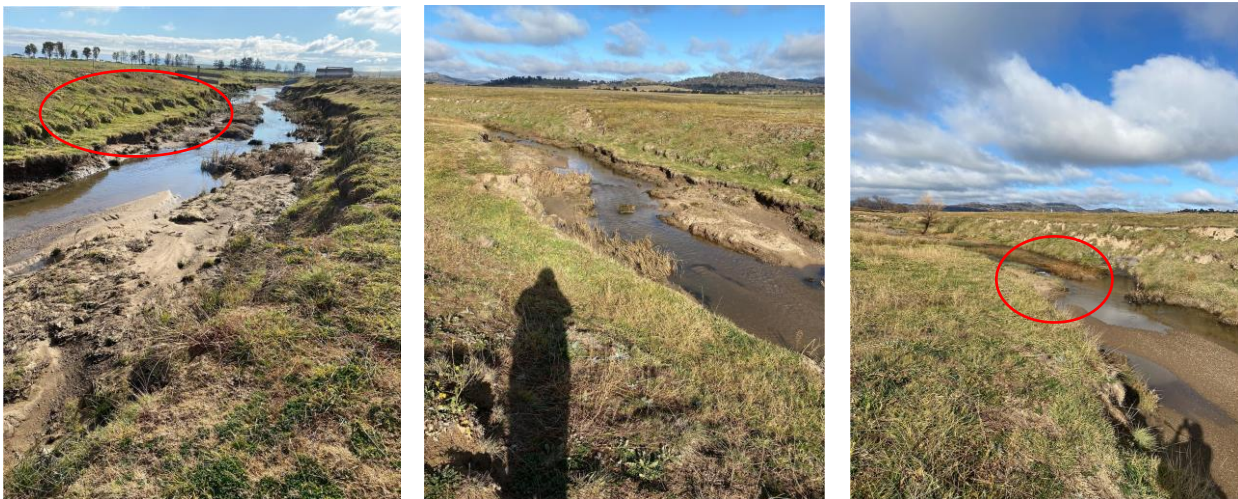
Map prepared by GrassRoots Environmental. While all care is taken to ensure accuracy, it cannot be guaranteed that it is free from errors. Base layers were obtained with permission from the ACT Government spatial database.

JC 1 This is a deposition zone where unconsolidated sediment is re-eroding. It is a suitable place for the placement of logs and rocks in order to maintain & enhance the existing riffle sequence. There are also a number of old steel posts along West Bank which are the remnants of old tree guards which should be removed (see photo below left). They are hazardous and serving no purpose. The flood gate on the reserve boundary is also in disrepair due to flooding and needs restoring. It was not stock proof at the time of inspection.

JC 2 This is a deposition zone with a small amount of bank erosion. There is some channel widening with increased flow. Reeds should be planted along the toe of the bank (where the channel meets the bank wall) to reduce the erosive forces of water velocity. This will offer protection from small frequent flows and improve bank resilience. There are also old tree guard posts in this section that need removing.

JC 3 There is a small head cut (nick point) in the base of the channel which is actively eroding (see photo below right). In A small riffle sequence can be constructed with rock to maintain the deposition zone above. Rocks need to be angular, of various sizes (up to 50mm) and keyed into the stream bed. This is not intended to be major works but a small structure that slows the rate of movement of the head cut.

Photos 5, 6, 7 from left to right: JC1 showing steel posts, JC2 deposition zone, and JC3 showing erosion nick point.



JC 4 This is a good area for in-stream works, such as rock groynes which redirect flow back into the centre of the channel. These will need to be properly designed and constructed and keyed well into the banks. Planting of reeds and other aquatic vegetation will help to stabilise soil and slow flow in this area. These will need to be properly designed and constructed and keyed well into the banks. Planting of reeds and other aquatic vegetation will help to stabilise soil and slow flow in this area.

JC 5 This is an area where the channel is eroding and there is risk of the flow being redirected into the bank. While channel redirection is a natural process to some degree in natural systems, it is exacerbated by higher flows in the catchment and the channelisation of what once were swampy meadows. Rock armouring is therefore advisable to prevent channel redirection and reduce the release of a high volume of sediment downstream.

JC 6 Another good area for in-stream works. The channel is wide and lends itself to a mixture of woody debris, riffles and reeds to improve structural complexity which builds on the features already present in the stream. The whole reach that incorporates JC4 ,JC5 and JC6 is a good focus point for a variety of in-stream works. Adjacent flood runners should be planted heavily with *Poa labillardieri* and *Carex appressa* to reduce lateral flow velocity.

Photos 8,9,10 (clockwise from left): JC4 – JC6 which (combined) are a good area to focus in-stream works.



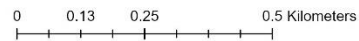
Map 14 Jerrabomberra Creek Jerrabomberra Grasslands East Middle Section



Sources: Earthstar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Jerrabomberra Creek in Jerrabomberra Grasslands: Middle Section On-Ground Works

- In Channel Works
- Proposed Revegetation Woodland
- Environmental Offsets
- Proposed Reveg Poa Carex Only
- Proposed Fencing
- Threatened_Species_records_1819



GrassRoots Environmental

Map prepared by GrassRoots Environmental. While all care is taken to ensure accuracy, it cannot be guaranteed that it is free from errors. Base layers were obtained with permission from the ACT Government spatial database.

JC 7 This area is a reestablishing wide swampy meadow and prevention of further erosion is important by ensuring in-stream vegetation remain to colonise the toe of the bank. Wetland plants such as *Carex* and *Poa* should be allowed to regenerate and enhanced with further planting.

JC 8 This is one of the only areas along the creek recommended to be planted with woodland species (*Eucalyptus melliodora*, *Eucalyptus polyanthemos*, *Eucalyptus blakelyi*, *Acacia implexa*, *Acacia genistifolia*). The topography is higher than the creek and there are a small number of remnant trees which could be enhanced. There is also a row of planted Conifers which are posing little threat to biodiversity and can be left in situ. The threatened White-winged Triller has been recorded in the trees in this location. Planting trees in this area does not encroach on threatened grassland species such as the Golden Sun Moth and Grassland Earless Dragon. Site preparation should consist of auger holes with Glyphosate overspray of a 1m diameter. Green Guards should be used to reduce grazing pressure on the trees.

Photo 11: JC8 showing an area suitable for revegetation.



JC 9 This is an indicative fenceline in response to a request from AMC management to fence the creek to manage domestic stock in the paddocks adjacent to the AMC. Particular attention should be paid to maintaining 100% groundcover at all times, by ensuring domestic stock numbers are aligned with paddock carrying capacity. The creek itself should remain ungrazed by domestic stock to allow nutrients to rebalance, enable the regeneration of desirable species such as *Poa* and *Carex*, and promote bank stability.

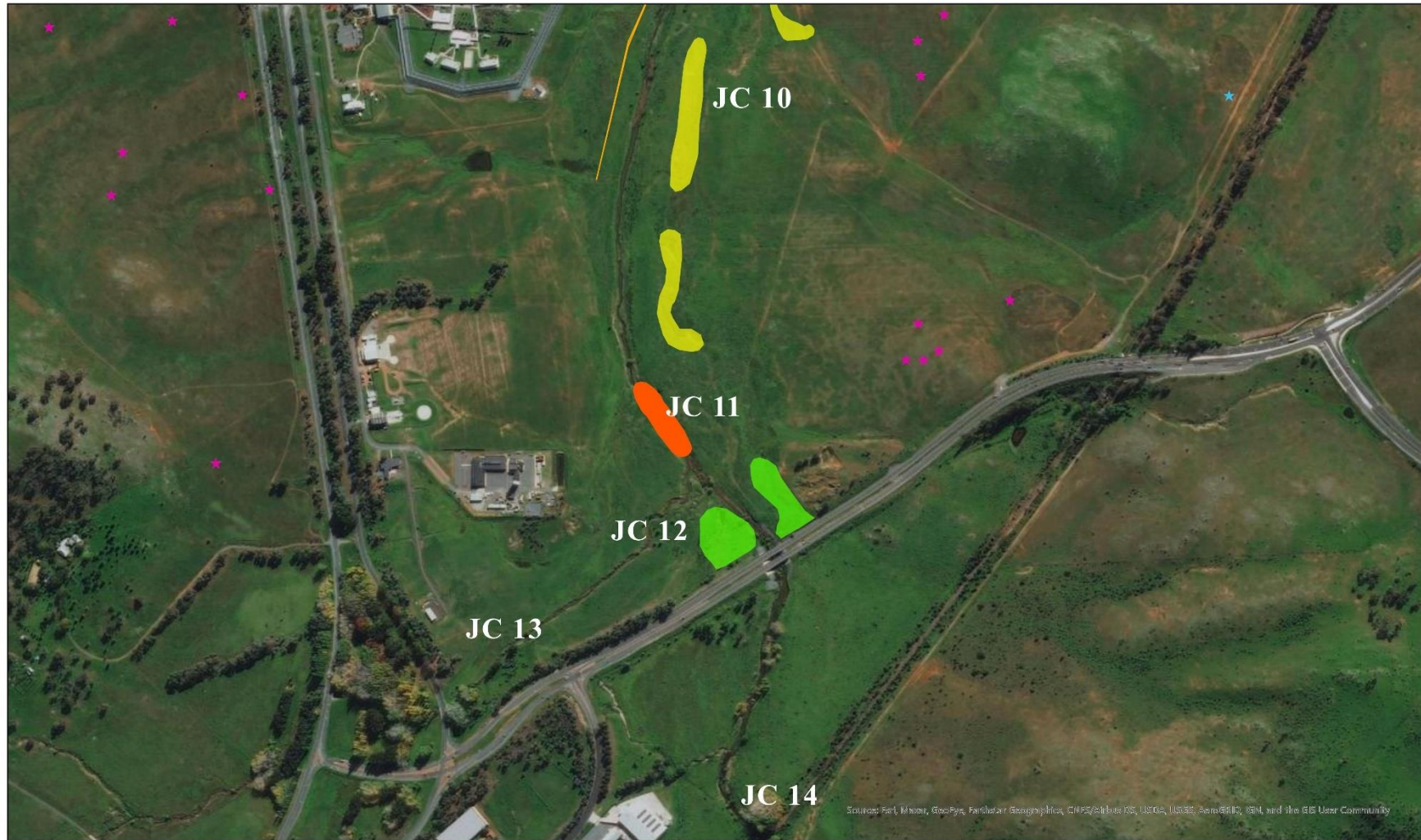
JC 10 As per JC 9, the creek channel and flats should remain ungrazed by domestic stock. There are large areas of exotic plants which are responding to high levels of nutrients in the soil (particularly phosphorus) mostly in association with grazing. These will ultimately break down and form organic matter. Most of the weeds are herbaceous annual weeds such as *Verbascum*, *Paterson's Curse* and *Thistle*, which will eventually start to reduce with intact groundcover competition. However, they will need to be contained within the areas they are currently in to prevent spread into clean areas.

The areas recommended for Poa and Carex revegetation (as indicated on Map 14), are focussed on expanding current locations of existing Poa and Carex dominated areas as a priority over the next 5 years. This does not exclude planting windows of these plants in areas dominated by weeds – it is simply a question of resources and prioritisation based on the premise of protecting and expanding on existing natural values.

Photo 12 on left Poa and Carex regeneration which should be promoted (AMC in background JC 9) and photo 13 on right: Weeds responding to high nutrients and bare ground from drought followed by rain (JC 10)



Map 15 Jerrabomberra Creek Jerrabomberra Grasslands East Southern Section



Source: Air, Photo, GeoEye, Earthstar Geographics, CNR AeroGlobe, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Jerrabomberra Creek in Jerrabomberra Grasslands: Southern Section On-Ground Works

- In Channel Works
- Proposed Fencing
- Proposed Revegetation Woodland
- Proposed Reveg Poa Carex Only
- Threatened_Species_records_1829

0 0.17 0.35 0.7 Kilometers



GrassRoots Environmental

Map prepared by GrassRoots Environmental. While all care is taken to ensure accuracy, it cannot be guaranteed that it is free from errors. Base layers were obtained with permission from the ACT Government spatial database.

JC10 – see previous section.

JC 11 There are some areas of small-scale erosion which is the consequence of higher rates of flow coming from the catchment than the channel is adapted to. The channel may have constricted during drought years, or there may be more water coming off the catchment in response to urban development. Either way, the channel is widening in places causing some small-scale erosion. This can be treated using reeds and the strategic placement of woody debris to soften the force of the flow into the toe of the bank.

Photo 14 on left shows small scale channel widening in response to higher flows (JC11) and Photo 15 on right shows the establishment of problem willows from source populations upstream (JC13 and JC14). Both photos show woodland vegetation which can be enhanced (JC12).



JC 12 These two areas are suitable for revegetation with woodland species to enhance and extend on revegetation that has been undertaken in the past. It is an ecotonal area between the naturally treeless creek and adjacent woodlands.

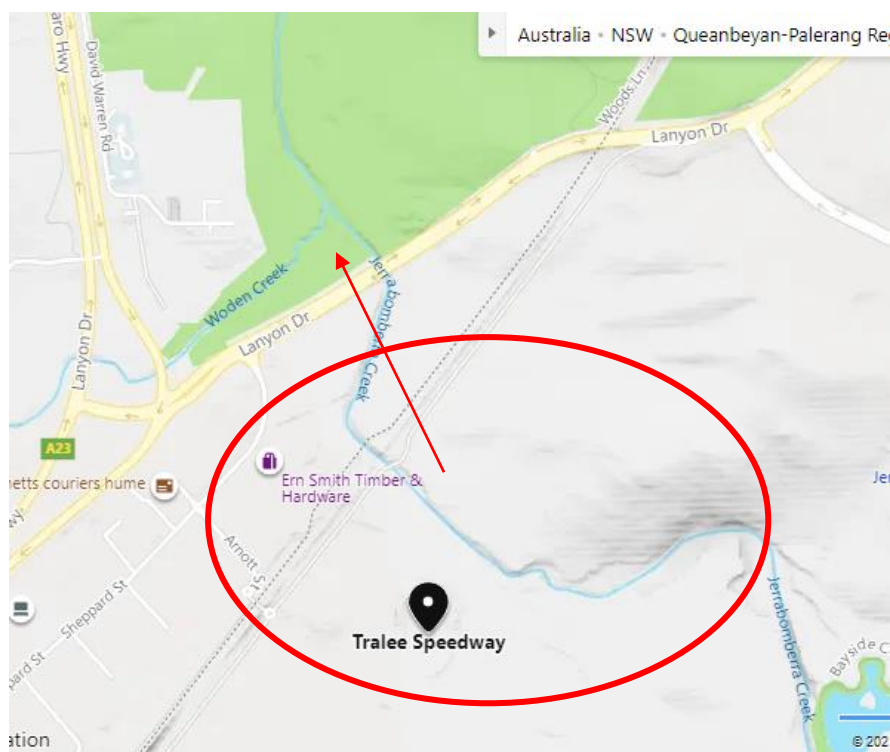
JC 13 and **JC 14** are both source areas for a number of problem willow species including Crack Willow, Tortured Willow, and Crack x Tortured Willow hybrids (among other things). These spread easily by both seed and vegetatively depending on the species. As the source populations are unlikely to be addressed in the near future (if at all) an ongoing program of willow controlled will be required along the creek within the reserve. Getting willows under control when they are small is relatively straightforward via overspray or cut and paint methods. Leaving them will result in a costly control program which may result in changes to flow (depending on their density) and shade. Old Weeping Willows can generally be left in place as their rate of spread is slow and young ones can be controlled as part of an ongoing willow management program.

JC14 is occasionally agisted for domestic stock grazing. While the provision of a strategic grazing plan is outside the scope of this Plan, there are some principles that should be adhered to. Firstly, the purpose of the grazing should be fully understood (e.g. stock feed, fire fuel management, biodiversity management, weed suppression and so on), as this will determine the timing and duration of the grazing. It is also worth asking whether grazing is required at all? Regardless, it is important to ensure that 100% groundcover is maintained at all times. Large numbers of animals grazed for short durations is preferable to smaller numbers over long

time frames (or set stocking) as this helps to ensure that they eat the full variety of plant species and don't just pick out the palatable species (thereby reducing diversity). It is advisable for staff to gain a good understanding of the effects of grazing on biodiversity in order to develop an appropriate grazing management strategy for the grasslands. More information can be found in [Effects of stock grazing on biodiversity values in Temperate Native Grasslands and Grassy Woodlands in SE Australia: A literature Review \(act.gov.au\)](#).

The area between JC12 and JC13 includes the confluence of the Woden Creek with Jerrabomberra Creek. Maintenance of vegetation cover (particularly a variety of grasses and in-stream vegetation) is critical for buffering catchment activities and filtering run off. Most of the Woden creek is well vegetated with grasses and aquatic vegetation, however there are parts of it that remain grazed by livestock, and / or receive drainage water from near-by roads and industrial areas, which potentially impact on water quality. As these pressures are unlikely to change in the near future, actions should focus on maintaining and improving vegetation cover within the reserve areas at least over the short term.

This area is also home to the only observed Wombat at the Jerrabomberra East and Bonshaw grasslands. Wombat populations generally increase in response to an improvement in the availability of grasses (e.g. where domestic stock grazing has been removed) and suitable digging sites such as along the banks of creeks and drainage lines. The Wombat in residence most likely has suitable conditions for it to happily exist, however may be cut off from other Wombat populations due to an intensive network of roads, urban development and other pressures. For example, there is a healthy population along the Jerrabomberra Creek at the now disused Tralee speedway which have responded well to the lack of human use. As this site is earmarked for sport and recreational development, there may be scope to investigate the possibility of the relocation of wombats downstream into the grasslands reserve area if they do not move naturally (which they will do if there are no major barriers to their movement). It is recommended that PCS staff contact Queanbeyan Palerang Council staff to discuss this further, as they are committed to ensuring that all the wombats are protected throughout the redevelopment process.



Map 16 Tralee Speedway Redevelopment Area. This is home to a large number of wombats which are likely to disperse downstream along the Jerrabomberra Creek once redevelopment commences (providing there are no significant barriers in the way).

7.8.7 On Ground Action Plan

This section brings together specific activities to achieve land improvement objectives over the next five years. Overarching outcomes include:

- Improved water quality – reduced sedimentation and nutrification.
- Increased biodiversity, habitat and connectivity – terrestrial and in-stream biodiversity.
- Improved soil health.
- Increased landscape resilience in the face of increased urban development and climate change.

Monitoring and Evaluation

A monitoring and evaluation program should be set up prior to undertaking works. This is important to measure success and to inform ongoing management in an adaptable framework. A simple, well-planned monitoring approach, appropriate to the planned outcomes of a program, is preferable to a complex research-oriented monitoring program that is difficult to understand, time consuming and difficult to analyse and interpret. Research programs of this nature are better designed and carried out by subject matter experts to answer specific questions. Therefore, the recommended monitoring methodologies outlined below are designed to assess change across the site and to record the outcomes of specific activities at a basic level.

- Photopoints – set up at 200m intervals, 10m from the Jerrabomberra Creek channel on the right bank (facing downstream). Install a ground level peg, GPS the location on Collector. Stand at the post and take a photo to the N, S, E and W with the horizon located in the centre of the photo. Take photos at each point twice per year at the start of spring and autumn (as a minimum). Take photos more frequently if resources allow particularly after flooding or dramatic changes in climatic conditions (flood and drought).
- Photo records of works – take photos when works are undertaken such as placement of woody debris in-stream and / or planting, before, during and after works. The location of these works should be recorded on Collector and photos labelled accordingly. Photos can be undertaken at intervals (e.g. when formal photo monitoring is undertaken) however the timing of follow up photos is not critical. These are to assist evaluation of the success of works.
- Willow presence / absence (direct counts). Record regenerating plants on Collector to plan control activities.
- Percentage cover of groundcover (can be bare ground v native plants v exotic plants) in a defined area or can be species specific if more detail is required. This can be as simple as estimating bare ground as while taking photopoints, or if desirable in defined areas (plots). An easy way to do this is to establish a 50 x 30m plot using the photopoint post as the corner of the plot. The size and placement of the plots don't matter as long as they are consistent over. Establishing plots is not critical, as the purpose of monitoring groundcover is to inform grazing pressure management (and general species diversity), however it can be useful to compare defined areas over time. Whichever measure is used, it should be in line with available time and resources, and therefore achievable.
- Tubestock percentage survival. Count living verses dead plants and convert to a percentage.
- Waterwatch monitoring – the inclusion of two sites (upstream and downstream of the grasslands) would be of benefit as part of the CHIIP program to monitoring water quality long term. Macroinvertebrate assemblages are of particular interest with the improvement of in-stream complexity.
- Rapid Appraisal of Riparian Condition (optional). RARC is a technique used for monitoring riparian condition and is an option for monitoring overall condition change along Jerrabomberra Creek. However, the scores would need to be corrected for naturally treeless swampy meadows. Refer to [2648 RARC_1.indd \(arcc.com.au\)](#) for details. Some basic training is required but it is a simple and effective method. RARC is often undertaken as part of Waterwatch monitoring and should be incorporated in association with setting up new Waterwatch sites.

Action Plan

| Management Objective | Actions | Location | Priority | Method | 5-year Target (Measure of Success) | Indicators |
|---|--|-----------------|-----------|---|---|--|
| Maintain in-stream and terrestrial vegetation diversity. | Control problem willows and other exotic woody weeds. Control noxious weeds (Serrated Tussock, African Love Grass). | Entire creek | Very High | Stem injection of all problem willows. The few large old Weeping Willows can be retained where they are providing shade or are off-stream. Cut and paint, stem inject or overspray other exotic woody weeds. | 100% reduction in problem willow species (all except Weeping Willows) and woody weeds. 90% reduction in priority noxious weeds as per PCS weed management program. | Number of living willows and woody weeds present (count). Location of noxious weeds mapped on Collector (ongoing). |
| Improve landscape connectivity for declining woodland birds especially White-winged Triller | Plant woodland species (<i>Euc.melliodora</i> , <i>E.polyanthemos</i> , <i>E.blakelyi</i> , <i>Acacia implexa</i> , <i>Acacia genistifolia</i>). | JC8, JC12, JC13 | Medium | Tubestock planting. Spot cultivation and spraying of holes for site preparation. Use of tall (600mm Green Guards to manage grazing pressure by rabbits and Kangaroos). Use large mesh guards for plantings in agisted areas (along Woden Creek). | Plantings undertaken with 90% survival. | Annual plant survival count (converted to percentage). Presence of bird species (incidental records or formal surveys). |
| Improve water quality (sedimentation and nitrification). | Undertake low key in-stream works to improve complexity and create deposition areas suitable for the growth of emergent aquatic plants (reeds and tussocks). | JC1 – JC7, JC11 | High | Strategic placement of large logs and root balls aligned 40 degrees along the bank and pointing downstream. Secure to bank with buried railway sleepers or similar if they can't be keyed into the bank effectively. Although risk is minimal (due to the distance to infrastructure and the flat | Woody debris placed in nominated areas. Reeds established in association with debris placement. Survival of 90% of planted aquatic vegetation. | Water quality monitoring (CHIP) – set up two new waterwatch sites upstream and downstream of in stream works. Record changes to plant diversity at location of structures and immediately downstream (photo monitoring and percentage cover of each species). |

| | | | | | | |
|--|--|-------------|-----------|--|---|---|
| | | | | <p>gradient), a risk assessment should be carried out prior to works. Recommend design advice from a fluvial geomorphologist for very large logs that may impact on infrastructure downstream.</p> <p>Planting / transplanting of reeds including <i>Phragmites</i>, <i>Schoenoplectus</i>, <i>Bulboshoenus</i> and <i>Eleocharis sp.</i> Typha will regenerate naturally in depositional areas.</p> | | <p>Mapping of works on Collector app. Take photos before, during and after installation of structures.</p> |
| | <p>Manage grazing pressure (kangaroos and rabbits) to ensure good groundcover along creek and adjacent catchment area at all times.</p> | Whole creek | Very High | <p>Monitoring and management of kangaroo numbers as part of ACT PCS KMP.</p> <p>Management of rabbit numbers as per PCS feral animal management planning.</p> <p>Exclusion of domestic stock.</p> | <p>90% groundcover along the banks of Jerrabomberra Creek and adjacent areas even during drought.</p> | <p>Percentage of bare ground.</p> <p>Photo monitoring.</p> <p>Monitoring of plots (if used). See monitoring and evaluation outline above.</p> |
| <p>Improve in-stream habitat and resilience and improve floodplain connectivity.</p> | <p>Combination of installation of in-stream structures, maintaining groundcover, planting in-stream vegetation and encouraging natural regeneration.</p> | Whole creek | Very High | <p>Recommended instream works outlined above. All actions combined will improve resilience and habitat.</p> | <p>Increase in channel complexity over 20% of channel area (compared with previous condition).</p> <p>Increase water retention in-channel (slowing of water flow by increasing complexity).</p> | <p>Combination of results of photo monitoring, water quality monitoring – with a focus on the results of macroinvertebrate surveys, and establishment and spread of in-stream vegetation.</p> |
| <p>Improve and expand swampy</p> | <p>Expand on existing swampy meadow areas dominated by Poa and Carex by planting</p> | JC 10 | High | <p>Densely plant Carex and Poa around existing patches (approximately 0.5m apart).</p> | <p>Expansion of swampy meadow areas.</p> | <p>Map via Collector and compare footprint with baseline mapping.</p> |

| | | | | | | |
|----------------------------|--|---|-------------------------------------|---|---|---|
| meadow habitat | tubestock or smaller enviro cells. Control all weeds in these areas. | | | Stem inject woody weeds, slash herbaceous weeds prior to seeding. | | |
| Reduce high soil nutrients | Contain large patches of annual herbaceous weeds to use up excess phosphorus and provide soil organic matter to ultimately create conditions suitable for native grasses. This is a long-term strategy which aims to reduce the footprint of these species. Phalaris has naturalised in many areas. This is likely to persist and is difficult to control. Contain as per herbaceous weeds. | Large patches of herbaceous weeds and Phalaris dominated areas. | Medium (long term ongoing strategy) | Contain large patches of herbaceous weeds (e.g. Thistle, Paterson's Curse, Mustard Weed and others). Slash in accessible areas to reduce seeding. Retain groundcover to reduce the ability of these species to spread. Control Phalaris in native-dominated areas and plant densely with Poa and Carex species to replace it. | Reduction in the footprint of herbaceous weeds and increase in native tussock grasses. No expansion of Phalaris into native-dominated areas. | Map large patches of herbaceous weeds and Phalaris via Collector to obtain baseline. Re-map in year 2 and year 5. |

Table 21 Action Plan for Jerrabomberra Creek (Grasslands Area)

Summary of Actions Over 5 Years (in order of priority)

| Activity | Priority |
|--|---------------------|
| Set up monitoring photopoints (and plots if desired) | Very High |
| Control problem willows | Very High |
| Control noxious weeds (Serrated Tussock, African Love Grass, Woody Weeds) to prevent spread into clean areas | Very High |
| Manage grazing pressure by rabbits, kangaroos and domestic stock as per PCS Strategies | Very High (ongoing) |
| Plant Carex and Poa (in identified areas) | High |
| Set up waterwatch monitoring sites x 2 | High |
| Install in-stream structures (in identified areas) | High |
| Contain spread of annual herbaceous weeds | Medium |
| Plant woodland species (in identified areas) | Medium |

Table 22 Summary of Actions and Priorities

7.8.8 Future Community Engagement and Funding Opportunities

Being government-managed land, community engagement opportunities are numerous and there is funding already attached to remediation activities and ongoing monitoring through citizen science. Discreet activities, such as soft engineering works and revegetation, might lend themselves to community working bees, and/or take on more of an 'adopt a patch' approach with various groups such as Traditional Owners, Landcare community members, ACT Young Rangers Club and individual volunteers. Once a works plan has been developed, different community groups can be matched to particular actions and approached to determine their level of interest. The Parkcare Program provides an existing framework through which to develop a community engagement program. Water quality monitoring can be undertaken as part of the ACT Waterwatch program by establishing 2 new sites upstream and downstream of management focus areas (as per on ground works maps).

There are also a number of Indigenous organisations and school groups that would be interested in Connection to Country activities for children such as Gugan Gulwan and other cultural program coordinators in schools.

Next Steps

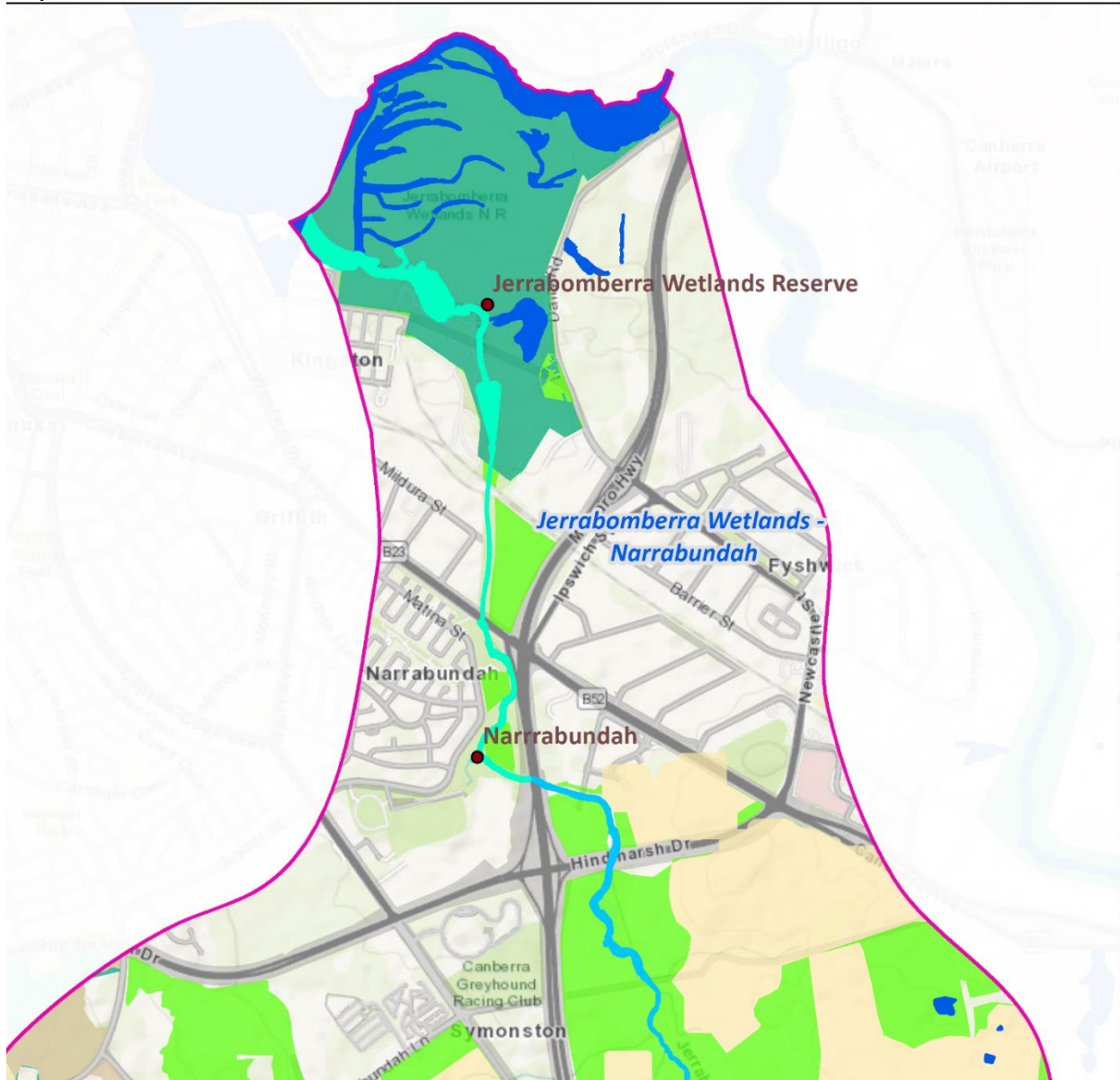
- Program the identified works including the engagement of a fluvial geomorphologist or engineer to design placement of in-stream structures.
- Liaise with the Waterwatch team to establish two new monitoring sites.
- Liaise with Traditional Owners to investigate traditional land management opportunities.
- Develop a community engagement plan.

Key Contacts

- Traditional Owners – Dharuwa Ngunnawal Committee (EPSDD) and Ngunnawal Council of Elders in the first instance. Engagement of Indigenous businesses such as Buru-Ngunawal Corporation, Yurbay, TOACK, Clybucca and so on.
- ParkCare
- Waterwatch
- Molonglo Conservation Group
- Queanbeyan Palerang Regional Council
- Greening Australia
- Transport Canberra and City Services

7.9 Section 9 Narrabundah to (and including) Jerrabomberra Wetlands

Map 17 Narrabundah to Jerrabomberra Wetlands



Jerrabomberra Creek Management Sections

- Jerrabomberra Wetlands - Narrabundah
- Narrabundah - ACT/NSW Border

- ACT - NSW Border
- Planning Boundary
- Important_Wetlands
- Nature Reserves

- Threatened Species
- Grasslands
- Woodlands
- Blocks & Lots
- Roads

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The spatial data presented synthesises best available evidence relating to hydrology; however, it is meant to guide, not replace, field validation.



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25 March 2020

7.9.1 Context

This section of Jerrabomberra Creek Catchment is very urbanised and has been modified to manage drainage through urban areas. The vegetation along the creek consists of mostly mature exotic willow, elms, poplars and other species, although there have been some efforts to plant native vegetation in places. Recently there has been the installation of three wetland structures through the Healthy Waterways project, which involves the creek being diverted through wetland plant beds to improve filtration as it flows downstream.

The Jerrabomberra Creek ultimately flows through the Jerrabomberra Wetlands before it terminates in Lake Burley Griffin. Jerrabomberra Wetlands is a nationally important wetland known for its diversity of birds and as a haven for a range of other wildlife in the heart of Canberra. It is a hotspot for birdwatchers, photographers and those who like to get some exercise outdoors. The Jerrabomberra Wetlands is a novel ecosystem and is different to most nature reserves in that it has been significantly modified with the completion of Lake Burley Griffin in 1964, and the diversion of the Jerrabomberra Creek through a silt trap removing flow from the original creek channel. One of the Healthy Waterways projects has seen flow re-diverted back into the original creek channel, along with the planting of a large number of wetland plants.

Jerrabomberra Wetlands is managed through a partnership between the Woodlands and Wetlands Trust and the ACT PCS. It has its own management Plan and concept Plan, which guide specific activities, although these are constantly evolving as new programs emerge. Management programs and specific actions are also guided by a Jerrabomberra Wetlands Advisory Panel. The Jerrabomberra Wetlands Management Plan can be found at https://www.environment.act.gov.au/_data/assets/pdf_file/0010/390673/WEB_Jerrabomberra_MP.pdf

7.9.2 Important Natural Attributes

Jerrabomberra Wetlands is habitat for over 200 species of birds, six species of frogs, reptiles, turtles and other wildlife, right in the middle of the city. It is also important habitat for the Environment Protection and Biodiversity Conservation Act-listed Latham's Snipe, a migratory wader bird that breeds in Japan and overwinters in Australia. Research has demonstrated the importance of the Jerrabomberra Wetlands as a destination for these birds, with the same individuals returning year after year. The urban parts of the creek have low wildlife diversity in comparison to other parts of the catchment however the recent construction of wetlands and associated planting and weeding are working towards improving this.

7.9.3 Past and Current Projects

To date there has been a limited amount of conservation works in this section of creek with the exception of the Narrabundah area and the Jerrabomberra Wetlands. Narrabundah has an active community group hosted by the Old Narrabundah Community Council, who undertake activities to improve the creek through weed removal and revegetation and they have been doing this for many years. More recently there has been the construction of the Narrabundah Wetlands through the ACT Healthy Waterways project: [Wetlands - Narrabundah \(Fyshwick catchment\) - ACT Healthy Waterways](#) The Narrabundah community have adopted these wetlands and continue to host field days to raise awareness of the importance of wetlands, plant native vegetation and undertake weed control in partnership with the Molonglo Conservation Group.

The Jerrabomberra Wetlands have been significantly modified from the floodplains of the Molonglo River that they once were. They have a rich history including Second World War training trenches; the construction of a railway in the early 1920s (which ultimately washed away in a flood); dairy farming; the development of Lake Burley Griffin, as a repository of earth fill from new Parliament House; plantings of native species that may not have occurred there naturally; and invasion of non-native plants, as habitat for invasive species as well as native animals, all of which has resulted in the novel ecosystem that makes it unique when compared to wetlands in other parts of Australia. Being an important ACT nature reserve, it is managed for its values and management includes willow and weed control, ecological burning, planting, monitoring, research, citizen

science and extensive community engagement. The very active Friends of Jerrabomberra Wetlands carry out a lot of these activities in partnership with the rangers and Woodlands and Wetlands Trust.

7.9.4 Threats

There are a number of threats to the Jerrabomberra Wetlands including poor water quality runoff from industrial areas, lack of native vegetation along riparian zones, woody weeds and predation of turtle nests by foxes. Volunteers are addressing the turtle nest problem by using metal grids to protect the nests. Foxes and rabbits are also prevalent; and although they balance each other out to some degree, there are large numbers in surrounding areas making this difficult to address. Most of the groundcover is dominated by pasture grasses with cultural burning being used to increase native vegetation in wetter areas.

Although concerted action has been undertaken in the past, and the Friends of Jerrabomberra Wetlands continue to undertake small scale activities, the ongoing spread of problem willows and woody weeds along waterways continue to be a threat to the native diversity of Jerrabomberra Creek. A willow management plan needs to be developed to properly prioritise limited resources.

As these issues are outlined in more detail (along with background context) in the Jerrabomberra Creek Management Plan 2010, a summary only is provided here for the Jerrabomberra Wetlands section of the creek.

7.9.5 Recommended Actions

| Target Area for Action | Details |
|----------------------------------|--|
| Vegetation Enhancement | The planting of bare areas should continue, with a focus on riparian areas with locally native vegetation, as outlined in the Jerrabomberra Wetlands Vegetation Management Plan. Planting to enhance Narrabundah wetlands should continue to diversify existing vegetation and provide habitat for wildlife. |
| Groundcover / Biomass Management | There should be continuation of cultural burning to enhance wetland vegetation and reduce biomass and competition for native plants in the Jerrabomberra Wetlands. Domestic cattle are used to manage biomass in the area around the paleochannels to keep the grass at the desired length for the Latham's Snipe and other wetland birds. The cattle are on a rotational system designed to promote conservation values of the reserve as well as production. There is no requirement for biomass management along other parts of the creek other than mowing for amenity and the enhancement of human use. |
| Willows and Riparian Woody Weeds | Willows and woody weeds continue to be a threat, and in addition to the actions undertaken by the Old Narrabundah Community Council and Friends of Jerrabomberra Wetlands, a willow and woody weed management strategy needs to be developed to be able to prioritise and seek resources. |
| Weeds and Feral Animals | Weeds are controlled by contractors and volunteers on an ongoing basis however the issue is extensive and has reached a point where containment is a more feasible option (as opposed to outright control). A lack of follow up works often threatens control activities undertaken in the past and this should be a priority before new areas are addressed. Feral animals (in particular foxes, rabbits and cats) are not actively managed along this section of creek. There are constraints including a large source population, the balance between foxes and rabbits, the effects of which is largely unknown, and the high people use which impacts on the ability to shoot and undertake baiting programs. |

| | |
|--|--|
| Hydrological Enhancement / Erosion Control | With the implementation of the Healthy Waterways project, new wetlands have been installed and the lack of flow into the original Jerrabomberra Creek channel has been addressed through diversion works in the Jerrabomberra silt trap. Another area still to be addressed is the erosion between the silt trap and Jerrabomberra Creek in the wetlands and, ideally, the reinstatement of a more complex riparian zone. Other areas in this section of creek are largely stable. |
|--|--|

Table 23 Recommended Actions Narrabundah to (and including) Jerrabomberra Wetlands

7.9.6 Future Community Engagement and Funding Opportunities

Community engagement in the activities undertaken at the Jerrabomberra Wetlands is high, with a range of groups undertaking different roles at the Jerrabomberra Wetlands, overseen by ACT PCS and Woodlands and Wetlands Trust staff. On-ground works are largely undertaken by the Friends of Jerrabomberra Wetlands with the help of participants in Indigenous programs, corporate volunteers, Australian Defence Force Academy cadets, school groups, scouts and individuals. Monitoring is undertaken by Waterwatch, Frogwatch, Canberra Ornithologists Group, Friends of Jerrabomberra Wetlands and the Young Rangers Club. The Jerrabomberra Wetlands Advisory Panel guides decision making, with members volunteering for a range of tasks from on-ground works to planning, interpretations and administration. In addition, the Woodlands and Wetlands Trust runs an events program which attracts a diverse range of members of the community to engage with the wetlands. As mentioned, Narrabundah also has an active community group who cares for the creek and the new wetlands. Between these, there continues to be a range of opportunities for volunteers, and some of these people have indicated they would be happy to undertake initiatives along other parts of the Jerrabomberra Creek Catchment. The Molonglo Conservation Group is in a good position to work with staff and community volunteers to make this happen.

7.9.7. Next Steps

Next steps are a continuation of the works already being undertaken and the

- Further engagement of community in the Healthy Waterways program being implemented through the Molonglo Conservation Group.
- Ongoing liaison with Transport Canberra and City Services Directorate.
- A willow and weed management plan would be beneficial to prioritise works in order to effectively seek funding and resources.

7.9.8. Key Contacts

- Woodlands and Wetlands Trust
- Old Narrabundah Community Council
- Molonglo Conservation Group
- Transport Canberra and City Services Directorate

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Appendix A List of Planning Documents Relevant to the Jerrabomberra Creek Catchment

Important Note: Planning documents are being updated continuously and this list should be used as a broad guide only. It is not an exhaustive list but rather a snapshot. It is therefore important to check up to date plans and legislation when planning activities.

| |
|---|
| Australian Capital Territory |
| ACT State of the Environment Report (Commissioner for the Environment 2019) |
| ACT Strategic Bushfire Management Plan (SBMP) (ACT ESA 2019) |
| ACT Water Resources Plan (ACT Government 2019) |
| ACT Planning Strategy Refresh (ACT Government 2018) |
| ACT Biosecurity Strategy 2016-2026 (ACT Government 2016) |
| ACT and Region Catchment Strategy: 2016-46 (ACT Government 2016) |
| ACT Water Strategy 2014-44: Striking the balance (Environment and Planning Directorate 2014) |
| ACT Nature Conservation Strategy (ACT Government 2013) |
| ACT Pest Animal Management Strategy (ACT Government 2012) |
| Lake Burley Griffin Action Plan (Lake Burley Griffin Taskforce 2012) |
| ACT Planning Strategy (ACT Government 2012) |
| Jerrabomberra Wetlands Nature Reserve Plan of Management 2010 (ACT Government 2010) |
| ACT Natural Resources Management Plan (ACT Natural Resources Management Council 2009) |
| ACT Parks, Conservation and Lands Volunteer Policy (Parks, Conservation and Lands 2009) |
| ACT Aquatic Species and Riparian Zone Conservation Strategy (ACT Government 2007) |
| Lake Burley Griffin Willow Management Strategy (Gould 2006) |
| ACT Lowland Native Grassland Conservation Strategy (ACT Government 2005) |
| Think Water, Act Water – Strategy for Sustainable Water Resource Management in the ACT (Environment ACT 2004) |
| ACT Lowland Woodland Conservation Strategy (ACT Government 2004) |
| Threatened Species Action Plans – Natural Temperate Grassland, Earless Dragons, Golden Sun Moth, Perunga Grasshopper, Button Wrinklewort, Legless Lizard, Peppercress (not sure if Jerra Creek site is included). Incorporated into other Strategies. |
| Regional |
| Molonglo Catchment Strategy 2015-2025 (Molonglo Catchment Group 2015) |
| NSW 2021 South East NSW Regional Action Plan (NSW Department of Premier and Cabinet 2012) |
| Molonglo River Rescue Action Plan 2010 (Bowman & Keyzer 2010) |
| The NSW Invasive Species Plan 2008-2015 (NSW Department of Primary Industries 2008) |
| Sydney–Canberra Corridor Regional Strategy (NSW Department of Planning 2008) |
| Regional Weed Strategy Murrumbidgee Catchment (Ash & Verbeek 2007) |
| A Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands 2002 (Faulding 2002) |
| New South Wales |
| Draft NSW Water Strategy (NSW Government 2020) |
| Native Vegetation Information Strategy 2014-2018 (NSW Government 2014) |
| South East Catchment Action Plan (South East Local Land Services 2014) |
| The South East Catchment Action Plan (CAP) 2013-2023 (NSW Government 2013) |
| NSW Biosecurity Strategy 2021 (NSW Government 2013) |
| South East NSW Regional Action Plan (NSW Department of Premier and Cabinet 2012) |
| Integrated Regional Vulnerability Assessment: South East New South Wales Pilot Study (NSW Office of Environment and Heritage 2012) |
| NSW Framework for Assessing and Recommending Upgraded Catchment Management Plans 2012 (NSW Natural Resources Commission 2012) |
| Queanbeyan River Corridor Plan of Management incorporating the Platypus Awareness and Conservation Strategy (Eco Logical Australia 2012a) |
| NSW Biodiversity Strategy 2010-15 (Department of Environment, Climate Change and Water NSW & Industry and Investment NSW 2010); |
| NSW Standard for Quality Natural Resource Management 2005 (www.nrc.nsw.gov.au/nrm-standard-and-targets) |

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|---|
| Local Government |
| Queanbeyan Palerang Local Environment Plan. 7 plans currently feeding into the 2020 Draft LEP |
| State of the Environment Reporting 2019 |
| Queanbeyan River Riparian Corridor Strategy (Eco Logical Australia 2012b). |
| Biodiversity Study Findings Report, Queanbeyan Local Government Area (Bushfire and Environmental Services 2008) |
| Jerrabomberra Creek Plan of Management (Queanbeyan City Council & Maunsell Australia 2006) |
| A Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands (Fallding 2002) |
| New South Wales Salinity Strategy (NSW Government 2000) |
| Sydney–Canberra Corridor Regional Strategy (NSW Government 2006) |
| Willow Management Strategy for the Upper Murrumbidgee Catchment (UMCCC 2010) |
| Stormwater Management Plans by Area (NSW Government) |
| Urban development Planning Documents by area (NSW Government) |